SOFTWOOD TREE VOLUME EQUATIONS FOR MAJOR CALIFORNIA SPECIES

by

Colin D. MacLean, *Mensurationist*

and

John M. Berger, *Mensurationist*

ABSTRACT

New cubic-foot, International 1/4-inch board-foot, and Scribner board-foot tree volume equations and tables are presented for eight species: Douglas-fir, Jeffrey pine, ponderosa pine, sugar pine, lodgepole pine, white fir, California red fir, and incense-cedar.

KEYWORDS: Cubic-foot volume tables (stand), board-foot stand volume tables.

INTRODUCTION

We have developed, for use in the Forest Survey of California,[1] new cubic-foot, International 1/4-inch board-foot, and Scribner board-foot tree volume equations for eight conifer species: Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), ponderosa pine (*Pinus ponderosa* Laws.), Jeffrey pine (*Pinus jeffreyi* Grev. & Balf.), sugar pine (*Pinus lambertiana* Dougl.), lodgepole pine (*Pinus contorta* Dougl.), white fir (*Abies concolor* (Gord. & Glend.) Lindl.), California red fir (*Abies magnifica* A. Murr.), and incense-cedar (*Libocedrus decurrens* Torr.).

Previously, Forest Survey has relied on a series of local volume tables (California Forest and Range Experiment Station, Forest Survey 1956) to compile timber volume statistics for California.[2] These tables assume average heights and form classes by site class based on Forest Survey data collected in the 1940's. The old tables no longer meet Forest Survey needs because (1) we are now interested in an accurate assessment of the volume on individual plots, for which we need volume estimates that take into account individual tree height variation; (2) height over d.b.h. and form class over d.b.h. ratios based on 25-year-old data may not accurately describe today's forest; and (3) the International 1/4-inch board-foot local volume tables assume a top utilization that does not conform with Forest Survey standards.

To replace the old tables, we needed volume equations that would provide comparable estimates of cubic, International 1/4-inch, and Scribner volume to Forest Survey utilization standards. The only existing tables suitable for statewide use (Clements and others 1949a, 1949b) were available only for the Scribner rule and varied by merchantable log height--a variable that is less desirable than total height for use on permanent plots. We therefore chose to develop our own equations.

THE BASIC DATA

Our need was for volume equations suitable for use on trees throughout California. Ideally, for this purpose, we would have preferred a large sample of recently measured trees, drawn from the complete range of forest conditions found in the State. In practice, we were limited to available tree measurement data, since we had neither time nor funds to undertake our own measurements. The most readily available tree measurement data were assembled by Clements and others (1949a, 1949b) during the preparation of their form class volume tables for ponderosa pine, Douglas-fir, white fir, sugar pine, and red fir. The tables themselves are inadequate for our purposes because they are based on log height rather than total height and because they are developed only for the Scribner log rule. However, complete stem profiles are available for all the 2,110 trees used to develop the tables.

---

[1] A nationwide project of the U.S. Forest Service. The Pacific Northwest Forest and Range Experiment Station conducts the survey in Alaska, California, Hawaii, Oregon, and Washington.

[2] Unpublished cubic and International 1/4-inch rule volume tables on file at the Pacific Northwest Forest and Range Experiment Station.

The felled tree measurements used for the form class volume tables were, for the most part, taken 50-70 years ago. Both young- and old-growth trees were included from a range of sites scattered from the Modoc plateau south along the Sierra Nevada to the Sierra National Forest. To this sample, we added 957 dendrometer-measured trees from recent inventories of the Eldorado and Sierra National Forests. The latter trees included small samples of lodgepole pine and incense cedar--two species not included in the form class volume tables.

Although the size of our sample was more than adequate, the reader should be aware of some important data deficiencies. First, two-thirds of the sample was drawn from trees measured many years ago. While we recognized the danger of bias inherent in the use of old data, that risk seemed preferable to relying on a much smaller sample with a limited geographical distribution. Second, we were unable to find measured-tree data from the Coast Ranges or, more important, for trees under 11.0 inches in diameter breast high. In the case of California red fir, all our sample trees were over 14 inches. This lack of small-tree data posed a particular problem in developing cubic-foot equations, since volumes were needed for all trees 5.0 inches and larger. We were forced to extrapolate, using comparisons of existing tables as a guide to reasonableness. Finally, our sample data for lodgepole pine and incense-cedar were limited--26 trees of the former species and 46 of the latter--and confined to the southern Sierra Nevada. In spite of these scanty data, we decided to develop volume equations for both species, as an alternative preferable to using equations developed for some other species.

DEVELOPING THE EQUATIONS

The STX program (Grosenbaugh 1967) was used to calculate three volumes for each of the sample trees: (1) CV_4--cubic-foot volume to a 4-inch minimum top d.i.b., (2) $IV1/4_{6.5}$--International 1/4-inch board-foot volume to a 6.5-inch minimum top d.i.b., and (3) SV_u--Scribner board-foot volume to a California utilized top as defined by a 1945 Forest Service study (California Forest and Range Experiment Station, Forest Survey 1956). The relationship of the utilized top d.i.b. to d.b.h. is shown in figure 1.
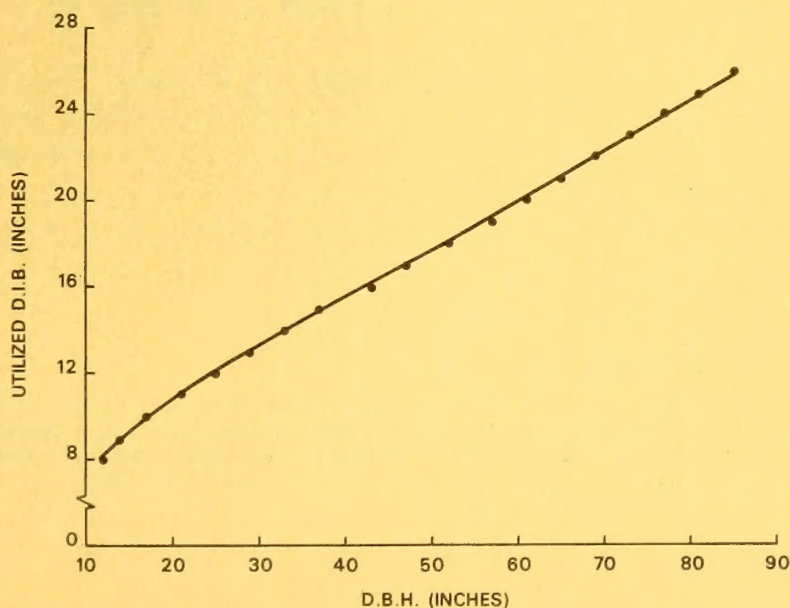

Figure 1.--Relationship of utilized top d.i.b. to d.b.h. (Based on 1945 Forest Service study.)

The method of analysis was essentially that used by Bruce and DeMars (1974). For each species and each log rule, tree volumes were fitted by weighted least squares by means of a stepwise multiple regression analysis. In order to obtain homogeneity of variance, each variable was divided by 0.005454154 (d.b.h.)^2 (total height)--the volume of a cylinder with a basal area and height equal to that of the sample tree. Our choice of independent variables was limited by the information available about the sample trees. Variables tested included d.b.h., total height, their powers, and cross products. Site class and age class (young growth or old growth) were also tried but dropped because their relative contribution to precision was small and their inclusion in the equations would have required the user to obtain site and age information.

The volume equations follow. Where applicable, restraints have been added to insure reasonable extrapolation. The following symbols have been used:

V = volume
D = diameter breast high
H = total height
F = form factor (the ratio of a tree's volume to that of a cylinder of the same diameter and height)
CF_4 = cubic-foot form factor
$IF1/4_{6.5}$ = International 1/4-inch board-foot form factor to a 6.5-inch top d.i.b.
SF_u = Scribner form factor (16-foot logs) to a California utilized top.[3]

To determine the volume of a given tree, first calculate the tree form factor, (transformed volume) using the appropriate equation for the species. Then multiply the form factor by the volume of a cylinder with the same height and basal area as the tree. Thus: $V = 0.005454154\ D^2H\ F$, where F is equal to the form factor appropriate for the species and log rule. The form factor equations are:

Species	Equation

Douglas-fir CF_4[4] $= 0.248569 + 0.0253524\ (\frac{H}{D}) - 0.0000560175\ (\frac{H^2}{D})$

$IF1/4_{6.5}$ (when $H \geq 57$ feet) $= 1.575350 - 1269.84\ (\frac{1}{DH})$

$+ 20.4816\ (\frac{1}{D}) + 0.0000135387\ H^2$

---

[3] See figure 1.

[4] For all species except incense-cedar, CF_4 will be set equal to 0.4 whenever the equation value is higher than 0.4. When the equation value for CF_4 is lower than 0.3, it is set equal to 0.3. This will insure reasonable extrapolation beyond the limits of the study data.

Douglas-fir $\qquad$ $IF1/4_{6.5}$ (when $H < 57$ feet) $= 1.575350 - 1269.84 \left(\frac{1}{DH}\right)$

$$+ 20.4816 \left(\frac{1}{D}\right) + 0.0000135387\ H^2$$

$$+ 7333.86 \left(\frac{1}{D^2H}\right) - 128.342 \left(\frac{1}{D^2}\right)$$

$$SF_u = 2.58530 - 83.5000 \left(\frac{1}{H}\right)$$

Ponderosa and
 Jeffrey pine $\qquad$ $CF_4 = 0.402060 - 0.899914 \left(\frac{1}{D}\right)$

$$IF1/4_{6.5} = 3.02027 - 22.0313 \left(\frac{1}{D}\right) + 0.00201362\ (H)$$

$$SF_u{}^{[5]} = 3.22940 - 585.500 \left(\frac{1}{DH}\right) - 21.7575 \left(\frac{1}{D}\right)$$

Sugar pine $\qquad$ $CF_4 = 0.358550 - 0.488134 \left(\frac{1}{D}\right)$

$$IF1/4_{6.5} = 2.75889 - 18.1229 \left(\frac{1}{D}\right) + 0.000225065 \left(\frac{H^2}{D}\right)$$

$$SF_u = 2.88706 - 25.2838 \left(\frac{1}{D}\right)$$

Lodgepole pine $\qquad$ $CF_4 = 0.422709 - 0.0000612236 \left(\frac{H^2}{D}\right)$

$$IF1/4_{6.5} = 2.86258 - 716.659 \left(\frac{1}{DH}\right)$$

$$SF_u = 2.63048 - 850.630 \left(\frac{1}{DH}\right)$$

White fir $\qquad$ $CF_4 = 0.299039 - 1.91272 \left(\frac{1}{H}\right) + 0.000367217 \left(\frac{H^2}{D}\right)$

$$IF1/4_{6.5}\ (\text{when } D \geq 11.0 \text{ inches}) = 2.08637 - 119.839 \left(\frac{1}{D^2}\right)$$

$$+ 0.000620285 \left(\frac{H^2}{D}\right)$$

$$IF1/4_{6.5}\ (\text{when } D < 11.0 \text{ inches}) = (0.45 + 0.05\ D)\ (1.09597$$

$$+ 0.000056389\ H^2)$$

$$SF_u = 2.31733 - 16.9592 \left(\frac{1}{D}\right) + 0.000548156 \left(\frac{H^2}{D}\right)$$

---

[5] SF_u will be set equal to 0.7 whenever it drops below this value to insure reasonable extrapolation from small trees. The volume of a tree with a minimum saw log diameter of 8 inches/inside bark by 12 feet long is 23 board feet.

California
red fir

$$CF_4 = 0.231237 + 0.028176 \left(\frac{H}{D}\right)$$

$$IF1/4_{6.5} = 1.54320 + 0.00133466 \left(\frac{H^2}{D}\right)$$

$$SF_u = 1.59669 - 464.752 \left(\frac{1}{DH}\right) + 0.00105105 \left(\frac{H^2}{D}\right)$$

Incense-cedar

$$CF_4 [6/] = 0.225786 + 4.44236 \left(\frac{1}{H}\right)$$

$$IF1/4_{6.5} = 1.39269 + 0.0000259631 \, H^2$$

$$SF_u = 1.82080 - 11.7184 \left(\frac{1}{D}\right)$$

Volumes calculated from these equations are in tables 1-21.

RELIABILITY OF THE EQUATIONS

One measure of the reliability of an equation is the extent to which the individual observations deviate from the regression surfaces. A measure of this residual variation is the root mean squared error--the square root of the mean squared difference between the predicted and actual values. Table 22 shows the root mean squared error of each form factor equation, expressed both in absolute terms and as a percent of the average form factor.

It is generally desirable to test new equations against an independent source of data--data not used in the construction of the equations. We tested the equations on 441 trees from the Stanislaus National Forest which had been measured with an optical dendrometer. The results of this test, together with the results of a test of the old Forest Survey local volume tables, appear in table 23. Figures 2-9 illustrate the relationship between estimated and actual volume of the test trees. As expected, the new equations, based on d.b.h. and total height, account for more of the variation in individual tree volume than do the old tables based on d.b.h. alone. The old lodgepole pine and incense-cedar tables gave very biased estimates of tree volume in this test. Tests against different trees in other geographic areas might well produce different biases. However, the new equations, which reflect differences in individual tree heights, should carry less risk of bias than the old tables, which rely on assumptions about the average relationships between heights and d.b.h. within a site class.

We also developed a complete set of volume equations which used Girard form class as one of the independent variables. When individual tree, Girard form class is known without error, these equations are more precise than the ones presented here. In practice, however, actual form class is seldom known. A common procedure is to use average form classes by species and sometimes by diameter class. We wondered whether the addition of form class would improve the estimate of individual tree volume when average form class was substituted for actual form class.

[6/] When the equation value for CF_4 is < 0.27, it is set equal to 0.27 to insure reasonable extrapolation.
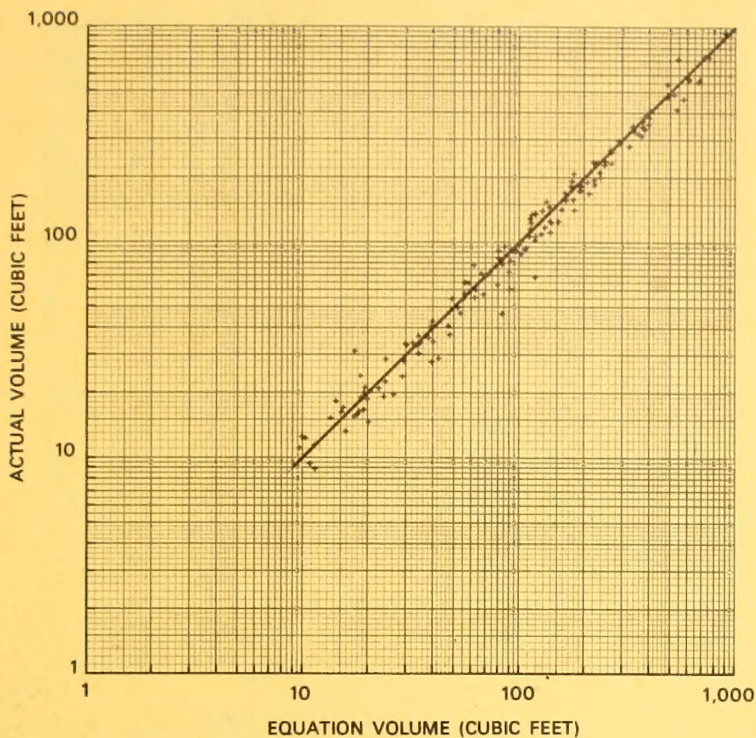
Figure 2.--Relationship between the measured cubic-
foot volume of 146 ponderosa and Jeffrey pine
trees and estimates from the new equation.
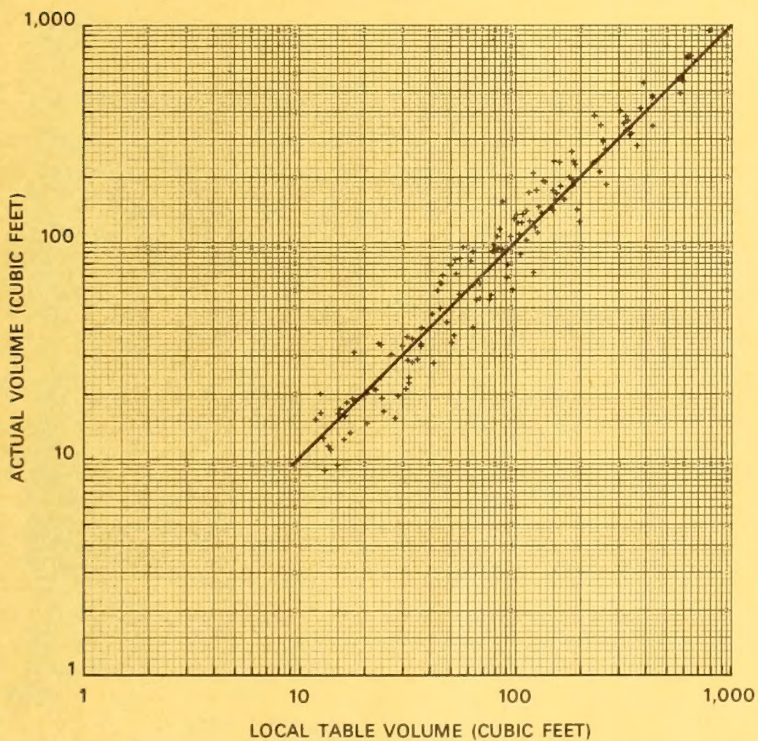
Figure 3.--Relationship between the measured cubic-
foot volume of 146 ponderosa and Jeffrey pine
trees and estimates from Forest Survey local
volume tables.

7
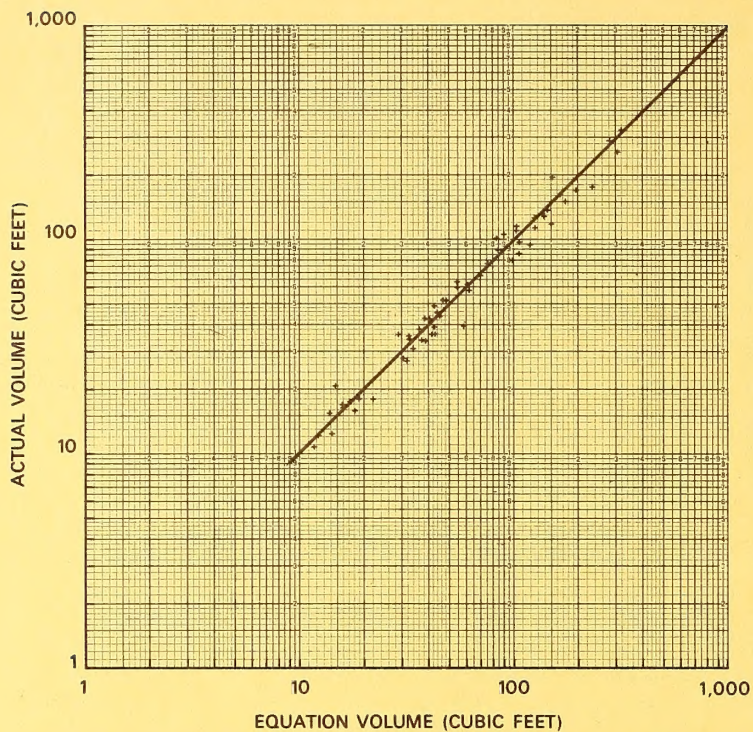
Figure 4.--Relationship between the measured cubic-
foot volume of 60 lodgepole pine trees and
estimated volume from the new equation.
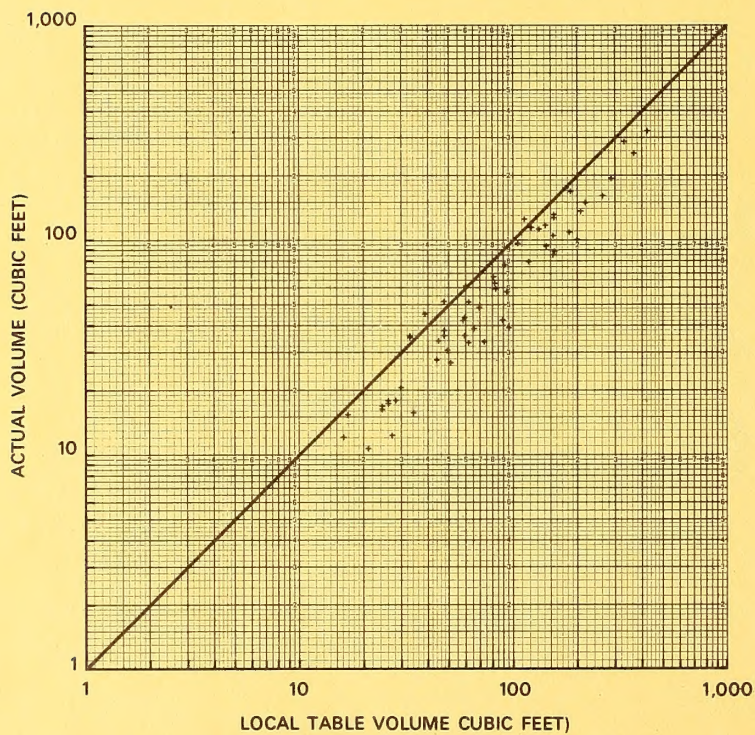
Figure 5.--Relationship between the measured cubic-
foot volume of 60 lodgepole pine trees and
estimates from the Forest Survey local volume
tables.
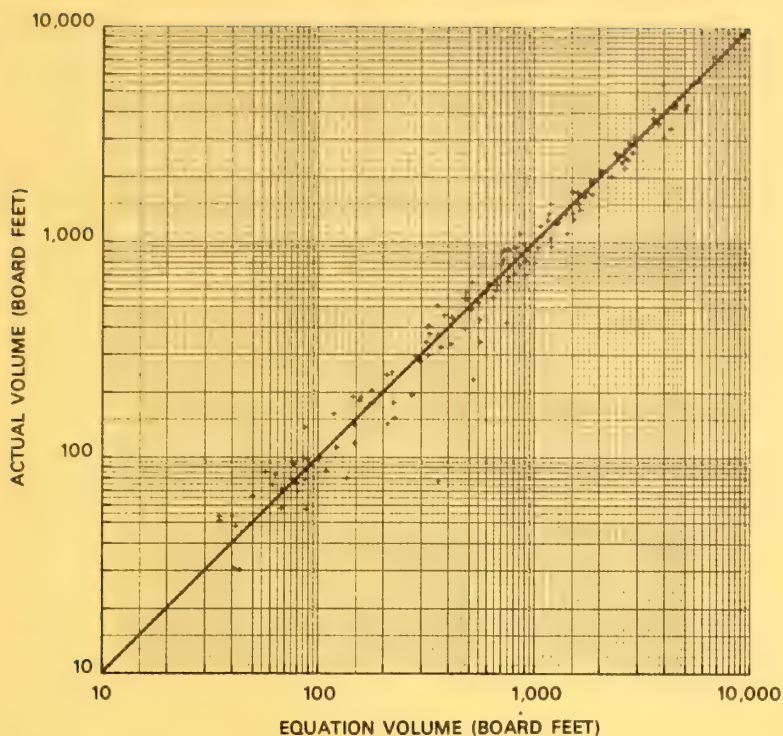
Figure 6.--Relationship between the measured Inter-
national 1/4-inch board-foot volume of 146 ponderosa
and Jeffrey pine trees and estimates from the new
equation.
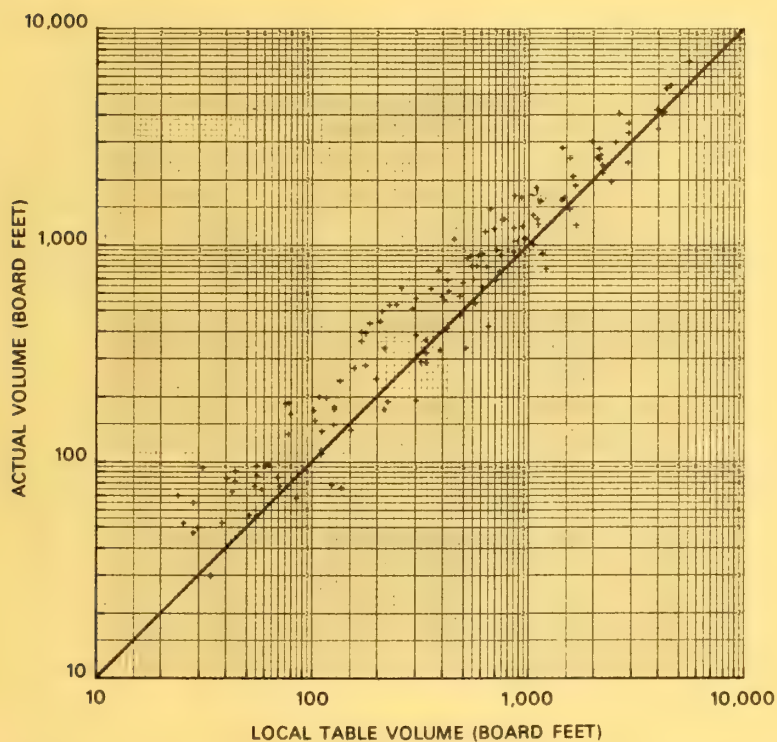
Figure 7.--Relationship between the measured Inter-
national 1/4-inch board-foot volume of 146 ponderosa
and Jeffrey pine trees and estimates from the Forest
Survey local volume tables.
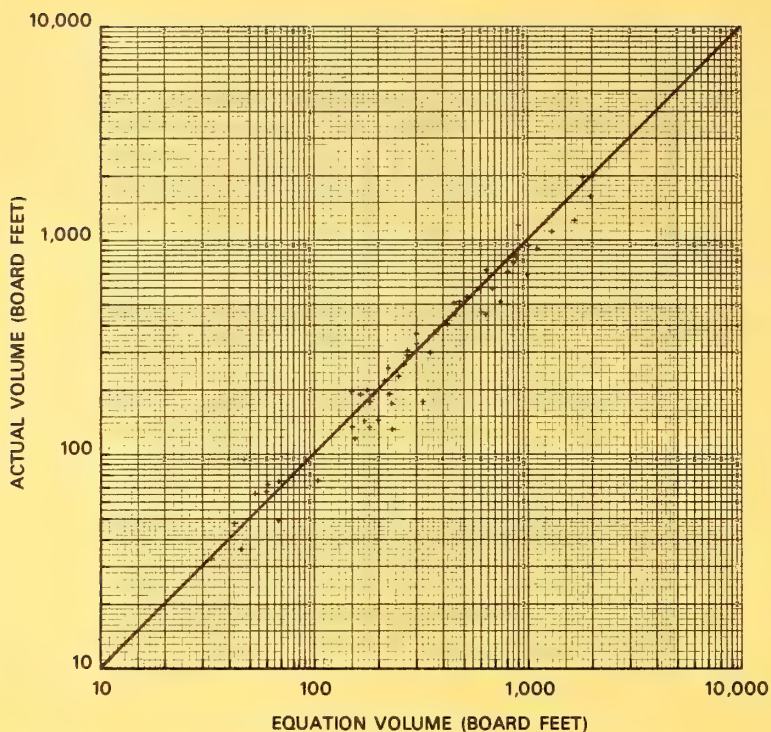
Figure 8.--Relationship between the measured International 1/4-inch board-foot volume of 60 lodgepole pine trees and estimates from the new equation.
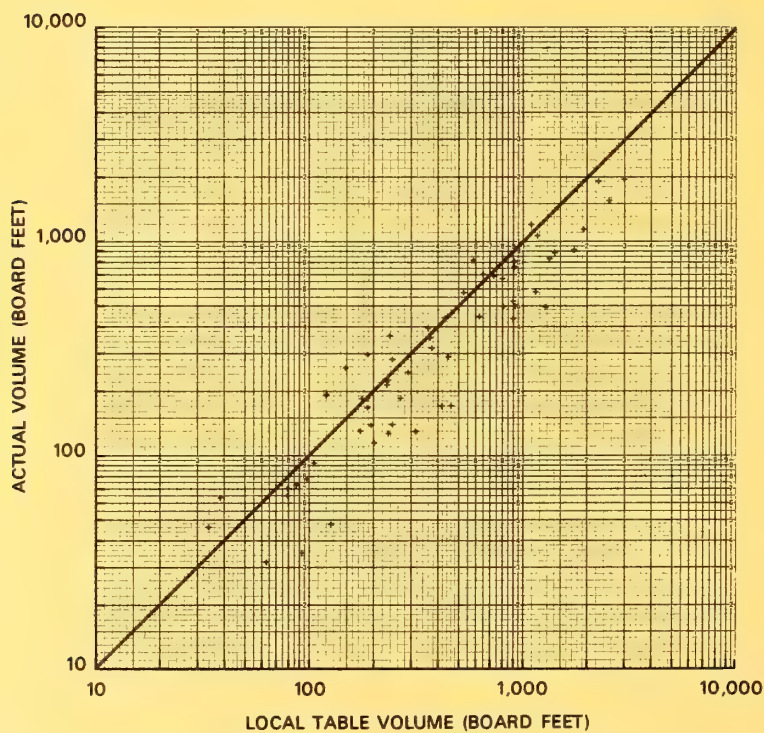
Figure 9.--Relationship between the measured International 1/4-inch board-foot volume of 60 lodgepole pine trees and estimates from the Forest Survey local volume tables.

To answer this question, we tested equations with and without form class against our 441 Stanislaus National Forest trees. The results of this test are in table 24. In this test, the extra precision gained by adding a form class variable was lost completely when average form class was substituted for actual form class, even though the actual average form classes of the test trees were used. We therefore decided not to include the form class equations in this note. We will be glad to supply the form class equations on request. However, we do not recommend their use unless form class is known for every tree.

LITERATURE CITED

Bruce, David, and Donald J. DeMars.
   1974. Volume equations for second-growth Douglas-fir. U.S. Dep. Agric. For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

California Forest and Range Experiment Station, Forest Survey.
   1956. Tenth-inch volume tables for the commercial conifer species of California. U.S. Dep. Agric. For. Serv., Calif. Reg., San Francisco, Calif.

Clements, V. A., C. W. Stevens, and D. F. Roy.
   1949a. Form-class volume tables for ponderosa pine, Douglas-fir and white fir in California. U.S. Dep. Agric. For. Serv., Res. Note 60, 126 p., illus. Calif. For. & Range Exp. Stn., Berkeley, Calif.

Clements, V. A., C. W. Stevens, and D. F. Roy.
   1949b. Form-class volume tables for sugar pine and red fir in California. U.S. Dep. Agric. For. Serv., Res. Note 61, 137 p. Calif. For. & Range Exp. Stn., Berkeley, Calif.

Grosenbaugh, L. R.
   1967. STX--FORTRAN-4 program for estimates of tree populations from 3P sample-tree-measurements. U.S. Dep. Agric. For. Serv., Res. Pap. PSW-13, 2d ed., rev., 76 p., illus. Pac. Southwest For. & Range Exp. Stn., Berkeley, Calif.

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Table 1.—Cubic-foot volume of Douglas-fir

Diameter breast height outside bark--inches[1]	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
6	3	4	5	5	6	7	8	9	9	10	11	12	13								
8	5	7	8	10	11	13	14	15	17	18	20	21	22								
10	7	10	12	15	17	20	22	24	26	28	31	33	35								
12	10	13	17	21	24	28	31	35	38	41	44	47	50								
14	13	18	22	27	31	36	42	47	51	56	60	64	68								
16	17	22	28	33	39	46	52	58	65	72	78	84	89								
18	21	27	34	41	48	56	63	71	79	87	95	103	111								
20	26	33	41	49	58	67	76	85	94	104	113	123	133	142							
22	32	40	49	59	69	79	89	100	111	122	133	144	155	166	177	188					
24	38	47	57	68	80	92	104	116	129	141	154	167	180	193	205	218					
26	44	55	66	79	92	106	120	134	148	162	177	192	206	221	235	249					
28		64	77	90	105	121	136	152	169	185	201	218	234	251	267	283					
30		74	88	103	119	137	154	172	190	209	227	245	264	282	301	319	337	354			
32		84	101	117	134	154	173	193	213	234	254	275	295	316	336	356	376	396	415		
34			113	132	151	172	193	215	236	260	283	306	329	351	374	396	418	440	462	483	
36			127	148	170	191	214	239	264	288	313	338	364	389	413	438	463	487	510	534	556
38				165	189	213	237	263	291	318	345	373	400	428	455	482	509	535	561	587	612
40				183	209	236	262	289	319	349	379	409	439	469	498	528	557	586	615	643	670
42				202	231	260	289	317	348	381	413	446	479	511	544	576	608	639	671	701	731
44				222	253	285	317	348	380	414	450	485	521	556	591	626	661	695	729	762	795
46				242	277	312	346	381	415	450	488	526	564	602	640	678	716	753	789	825	861
48				264	302	339	377	415	452	490	528	568	610	651	692	733	773	813	852	891	929
50				286	327	368	409	450	491	532	573	614	657	701	745	789	832	875	918	959	1,000
52						398	442	487	531	575	619	664	708	753	800	847	894	940	985	1,030	1,074
54						429	477	525	573	620	668	716	763	811	859	908	957	1,007	1,055	1,104	1,151
56						462	513	564	616	667	718	770	821	872	924	975	1,026	1,078	1,129	1,180	1,232
58						495	550	605	661	716	771	826	881	936	991	1,046	1,101	1,156	1,211	1,266	1,321
60						530	589	648	707	766	825	884	942	1,001	1,060	1,119	1,178	1,237	1,296	1,355	1,414
62									755	818	881	943	1,006	1,069	1,132	1,195	1,258	1,321	1,384	1,447	1,510
64									804	871	938	1,005	1,072	1,139	1,206	1,273	1,340	1,407	1,474	1,541	1,608
66									855	927	998	1,069	1,140	1,212	1,283	1,354	1,425	1,497	1,568	1,639	1,711
68									908	984	1,059	1,135	1,211	1,286	1,362	1,438	1,513	1,589	1,665	1,740	1,816
70									962	1,042	1,122	1,203	1,283	1,363	1,443	1,523	1,604	1,684	1,764	1,844	1,924
72											1,188	1,272	1,357	1,442	1,527	1,612	1,696	1,781	1,866	1,951	2,036
74											1,254	1,344	1,434	1,523	1,613	1,702	1,792	1,882	1,971	2,061	2,150
76											1,323	1,418	1,512	1,607	1,701	1,796	1,890	1,985	2,079	2,174	2,268
78											1,394	1,493	1,593	1,692	1,792	1,891	1,991	2,091	2,190	2,290	2,389
80											1,466	1,571	1,676	1,780	1,885	1,990	2,094	2,199	2,304	2,409	2,313

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Table 2.—Board-foot volume of Douglas-fir by International 1/4-inch rule

Diameter breast height outside bark-- inches 1/	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
10	22	35	51	72	93	114	136	158	181	204	228	252	277								
12	33	52	74	101	129	157	185	215	245	275	307	339	373								
14	46	72	101	135	170	206	242	280	318	357	397	439	482								
16	62	96	132	175	218	262	307	353	400	449	499	551	605								
18	81	123	168	219	271	324	379	435	492	551	612	675	740								
20	102	154	208	269	330	393	458	525	593	664	736	812	890	971	1,055	1,142					
22	127	188	252	323	395	469	545	623	703	786	872	961	1,053	1,148	1,247	1,350					
24	154	226	301	382	466	551	639	730	823	919	1,019	1,122	1,229	1,340	1,455	1,575					
26	184	267	353	447	543	640	741	845	952	1,062	1,177	1,295	1,418	1,546	1,679	1,818					
28		312	410	516	625	736	850	968	1,090	1,216	1,346	1,481	1,621	1,767	1,919	2,077					
30		360	472	591	713	838	967	1,100	1,237	1,379	1,526	1,679	1,838	2,003	2,175	2,354	2,541	2,735	2,938	3,150	3,371
32		411	537	670	807	947	1,091	1,240	1,394	1,553	1,718	1,890	2,068	2,253	2,447	2,648	2,858	3,077	3,306	3,544	3,793
34			607	755	907	1,063	1,223	1,389	1,560	1,737	1,921	2,112	2,311	2,518	2,734	2,959	3,194	3,439	3,694	3,961	4,240
36			681	844	1,012	1,185	1,362	1,545	1,735	1,931	2,135	2,347	2,568	2,798	3,037	3,287	3,548	3,820	4,104	4,401	4,711
38				939	1,124	1,313	1,509	1,710	1,919	2,136	2,361	2,595	2,838	3,092	3,356	3,632	3,920	4,221	4,536	4,864	5,207
40				1,039	1,241	1,449	1,663	1,884	2,113	2,351	2,597	2,854	3,121	3,400	3,691	3,994	4,311	4,642	4,989	5,350	5,728
42				1,143	1,364	1,590	1,824	2,066	2,316	2,576	2,845	3,126	3,418	3,723	4,041	4,374	4,721	5,084	5,463	5,859	6,273
44				1,253	1,492	1,739	1,993	2,256	2,528	2,811	3,105	3,410	3,729	4,061	4,408	4,770	5,149	5,545	5,958	6,391	6,843
46				1,367	1,627	1,894	2,170	2,455	2,750	3,056	3,375	3,707	4,053	4,413	4,790	5,184	5,595	6,026	6,476	6,946	7,438
48				1,487	1,767	2,056	2,354	2,661	2,981	3,312	3,657	4,016	4,390	4,780	5,188	5,615	6,060	6,526	7,014	7,524	8,058
50				1,612	1,914	2,224	2,545	2,877	3,221	3,578	3,950	4,337	4,740	5,162	5,602	6,062	6,544	7,047	7,574	8,125	8,702
52						2,399	2,744	3,100	3,470	3,854	4,254	4,670	5,104	5,558	6,032	6,527	7,046	7,588	8,155	8,749	9,370
54						2,581	2,950	3,332	3,729	4,140	4,569	5,016	5,482	5,969	6,477	7,009	7,566	8,148	8,758	9,396	10,064
56						2,769	3,164	3,572	3,996	4,437	4,896	5,374	5,873	6,394	6,939	7,509	8,105	8,729	9,382	10,066	10,782
58						2,964	3,385	3,821	4,274	4,744	5,234	5,744	6,277	6,834	7,416	8,025	8,662	9,329	10,028	10,759	11,524
60						3,165	3,614	4,078	4,560	5,061	5,583	6,127	6,695	7,288	7,909	8,558	9,238	9,950	10,695	11,475	12,292
62									4,856	5,388	5,943	6,522	7,126	7,757	8,418	9,109	9,832	10,590	11,383	12,214	13,084
64									5,161	5,726	6,315	6,929	7,571	8,241	8,942	9,676	10,445	11,250	12,093	12,976	13,900
66									5,475	6,074	6,698	7,349	8,028	8,739	9,483	10,261	11,076	11,930	12,824	13,761	14,742
68									5,798	6,432	7,092	7,780	8,500	9,252	10,039	10,863	11,726	12,630	13,577	14,569	15,608
70									6,131	6,800	7,497	8,225	8,985	9,779	10,611	11,482	12,394	13,350	14,351	15,399	16,498
72											7,914	8,681	9,483	10,321	11,199	12,118	13,081	14,089	15,146	16,253	17,414
74											8,341	9,150	9,995	10,878	11,803	12,771	13,786	14,849	15,963	17,130	18,354
76											8,781	9,631	10,520	11,449	12,422	13,442	14,509	15,628	16,801	18,030	19,318
78											9,231	10,124	11,058	12,035	13,058	14,129	15,251	16,428	17,661	18,953	20,308
80											9,692	10,630	11,610	12,635	13,709	14,834	16,012	17,247	18,542	19,899	21,321

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Table 3.—Board-foot volume of Douglas-fir by Scribner rule in 16-foot logs to a utilized top

Diameter breast height outside bark-- inches [1]	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
12	[2] 23	36	56	77	97	117	137	158	178	198	219	239	259								
14		49	77	104	132	159	187	215	242	270	298	325	353								
16		64	100	136	172	208	244	280	317	353	389	425	461								
18		81	127	172	218	264	309	355	401	446	492	538	583								
20		100	156	213	269	325	382	438	495	551	607	664	720	777	833						
22		121	189	257	326	394	462	530	599	667	735	803	872	940	1,008	1,076					
24		144	225	306	387	469	550	631	712	794	875	956	1,037	1,118	1,200	1,281					
26		169	264	359	455	550	645	741	836	931	1,027	1,122	1,217	1,313	1,408	1,503					
28		196	306	417	527	638	748	859	970	1,080	1,191	1,301	1,412	1,522	1,633	1,743					
30		225	352	478	605	732	859	986	1,113	1,240	1,367	1,494	1,621	1,748	1,874	2,001	2,128	2,255	2,382	2,509	2,636
32		256	400	544	689	833	978	1,122	1,266	1,411	1,555	1,700	1,844	1,988	2,133	2,277	2,421	2,566	2,710	2,855	2,999
34			452	615	778	941	1,104	1,267	1,430	1,593	1,756	1,919	2,082	2,245	2,408	2,571	2,734	2,897	3,060	3,223	3,386
36			406	689	872	1,054	1,237	1,420	1,603	1,785	1,968	2,151	2,334	2,516	2,699	2,882	3,065	3,247	3,430	3,613	3,796
38				768	971	1,175	1,379	1,582	1,786	1,989	2,193	2,397	2,600	2,804	3,007	3,211	3,415	3,618	3,822	4,025	4,229
40				851	1,076	1,302	1,527	1,753	1,979	2,204	2,430	2,655	2,881	3,107	3,332	3,558	3,784	4,009	4,235	4,460	4,686
42				938	1,187	1,435	1,684	1,933	2,181	2,430	2,679	2,928	3,176	3,425	3,674	3,923	4,171	4,420	4,669	4,918	5,166
44				1,029	1,302	1,575	1,848	2,121	2,394	2,667	2,940	3,213	3,486	3,759	4,032	4,305	4,578	4,851	5,124	5,397	5,670
46				1,125	1,423	1,722	2,020	2,318	2,617	2,915	3,213	3,512	3,810	4,109	4,407	4,705	5,004	5,302	5,600	5,899	6,197
48				1,225	1,550	1,875	2,199	2,524	2,849	3,174	3,499	3,824	4,149	4,474	4,799	5,123	5,448	5,773	6,098	6,423	6,748
50				1,329	1,682	2,034	2,387	2,739	3,092	3,444	3,797	4,149	4,502	4,854	5,207	5,559	5,912	6,264	6,617	6,969	7,322
52						2,200	2,581	2,963	3,344	3,725	4,106	4,488	4,869	5,250	5,632	6,013	6,394	6,775	7,157	7,538	7,919
54						2,373	2,784	3,195	3,606	4,017	4,428	4,840	5,251	5,662	6,073	6,484	6,895	7,307	7,718	8,129	8,540
56						2,552	2,994	3,436	3,878	4,320	4,763	5,205	5,647	6,089	6,531	6,974	7,416	7,858	8,300	8,742	9,184
58						2,737	3,211	3,686	4,160	4,634	5,109	5,583	6,057	6,532	7,006	7,481	7,955	8,429	8,904	9,378	9,852
60						2,929	3,437	3,944	4,452	4,960	5,467	5,975	6,482	6,990	7,498	8,005	8,513	9,021	9,528	10,036	10,543
62									4,754	5,296	5,838	6,380	6,922	7,464	8,006	8,548	9,090	9,632	10,174	10,716	11,258
64									5,065	5,643	6,220	6,798	7,376	7,953	8,531	9,108	9,686	10,263	10,841	11,419	11,996
66									5,387	6,001	6,615	7,230	7,844	8,458	9,072	9,686	10,301	10,915	11,529	12,143	12,758
68									5,718	6,370	7,022	7,674	8,326	8,978	9,630	10,282	10,934	11,586	12,238	12,890	13,542
70									6,060	6,751	7,441	8,132	8,823	9,514	10,205	10,896	11,587	12,278	12,969	13,660	14,351
72											7,873	8,604	9,335	10,066	10,797	11,528	12,259	12,990	13,721	14,452	15,183
74											8,316	9,088	9,861	10,633	11,405	12,177	12,949	13,721	14,493	15,266	16,038
76											8,772	9,586	10,401	11,215	12,030	12,844	13,659	14,473	15,287	16,102	16,916
78											9,240	10,097	10,955	11,813	12,671	13,529	14,387	15,245	16,103	16,960	17,818
80											9,719	10,622	11,524	12,427	13,329	14,232	15,134	16,037	16,939	17,841	18,744

1/ Diameter classes are midpoint; e.g. 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.
2/ The volume of a tree with a minimum saw log 8 inches d.i.b. and 12 feet long is 23 board feet. Trees lacking this minimum saw log have no Scribner volume.

Table 4.—Cubic-foot volume of ponderosa and Jeffrey pine

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Diameter breast height outside bark--inches 1/	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
6	2	3	4	4	5	5	6	6	7	8	8	9	9								
8	4	5	6	7	8	9	10	12	13	14	15	16	17								
10	7	9	10	12	14	15	17	19	20	22	24	26	27								
12	10	13	15	18	21	23	26	28	31	33	36	39	41								
14	14	18	22	25	29	32	36	40	43	47	51	54	58								
16	19	24	29	34	39	43	48	53	58	63	68	72	77								
18	25	31	37	44	50	56	62	68	75	81	87	93	100								
20	31	39	47	55	62	70	78	86	93	101	109	117	125	132	140	148					
22	38	48	57	67	76	86	95	105	114	124	133	143	153	162	172	181					
24	46	57	69	80	92	103	115	126	137	149	160	172	183	195	206	218					
26	54	68	81	95	108	122	135	149	163	176	190	203	217	230	244	257					
28		79	95	111	127	142	158	174	190	206	221	237	253	269	285	301					
30		91	110	128	146	164	183	201	219	237	256	274	292	310	329	347	365	384	402	420	438
32		104	125	146	167	188	209	230	251	272	292	313	334	355	376	397	418	439	459	480	501
34			142	166	189	213	237	260	284	308	332	355	379	403	426	450	474	497	521	545	568
36			160	187	213	240	267	293	320	346	373	400	426	453	480	506	533	560	586	613	640
38				209	238	268	298	328	358	387	417	447	477	507	536	566	596	626	656	685	715
40				232	265	298	331	364	397	431	464	497	530	563	596	629	662	696	729	762	795
42				256	293	330	366	403	439	476	513	549	586	623	659	696	732	769	806	842	879
44				282	322	363	403	443	484	524	564	604	645	685	725	766	806	846	887	927	967
46				309	353	397	441	486	530	574	618	662	706	750	795	839	883	927	971	1,015	1,059
48				337	385	434	482	530	578	626	674	723	771	819	867	915	963	1,012	1,060	1,108	1,156
50				367	419	471	524	576	628	681	733	786	838	890	943	995	1,047	1,100	1,152	1,204	1,257
52						511	567	624	681	738	794	851	908	965	1,021	1,078	1,135	1,192	1,248	1,305	1,362
54						552	613	674	736	797	858	919	981	1,042	1,103	1,165	1,226	1,287	1,348	1,410	1,471
56						594	660	726	792	858	924	990	1,056	1,122	1,188	1,254	1,320	1,386	1,452	1,518	1,585
58						638	709	780	851	922	993	1,064	1,135	1,206	1,277	1,348	1,418	1,489	1,560	1,631	1,702
60						684	760	836	912	988	1,064	1,140	1,216	1,292	1,368	1,444	1,520	1,596	1,672	1,748	1,824
62									975	1,056	1,138	1,219	1,300	1,381	1,463	1,544	1,625	1,706	1,788	1,869	1,950
64									1,040	1,127	1,214	1,300	1,387	1,474	1,560	1,647	1,734	1,820	1,907	1,994	2,080
66									1,107	1,200	1,292	1,384	1,477	1,569	1,661	1,753	1,846	1,938	2,030	2,123	2,215
68									1,177	1,275	1,373	1,471	1,569	1,667	1,765	1,863	1,961	2,059	2,157	2,255	2,354
70									1,248	1,352	1,456	1,560	1,664	1,768	1,872	1,976	2,080	2,184	2,288	2,392	2,496
72											1,542	1,652	1,762	1,873	1,983	2,093	2,203	2,313	2,423	2,533	2,644
74											1,630	1,747	1,863	1,980	2,096	2,213	2,329	2,446	2,562	2,678	2,795
76											1,721	1,844	1,967	2,090	2,213	2,336	2,459	2,582	2,705	2,827	2,950
78											1,814	1,944	2,073	2,203	2,333	2,462	2,592	2,721	2,851	2,981	3,110
80											1,910	2,046	2,183	2,319	2,456	2,592	2,728	2,865	3,001	3,138	3,274

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Table 5.—Board-foot volume of ponderosa and Jeffrey pine by International 1/4-inch rule

Diameter breast height outside bark-- inches 1/	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
10	20	25	31	37	43	49	56	62	69	76	84	92	99								
12	40	50	62	73	85	97	109	121	134	148	161	175	189								
14	65	83	101	119	137	157	176	196	217	237	259	280	303								
16	96	122	148	174	202	229	258	286	316	346	376	407	439								
18	133	168	203	240	277	315	353	392	432	473	514	556	599								
20	174	220	267	315	363	412	463	514	566	618	672	727	782	839							
22	222	280	339	399	460	523	586	651	716	783	850	919	989	1,060	1,132	1,204					
24	274	346	419	493	569	646	724	803	884	966	1,049	1,133	1,219	1,306	1,394	1,483					
26	332	419	507	597	688	781	875	971	1,068	1,167	1,267	1,369	1,472	1,577	1,683	1,790					
28		499	604	711	819	929	1,041	1,155	1,270	1,387	1,506	1,626	1,748	1,872	1,998	2,125					
30		586	709	834	961	1,090	1,221	1,354	1,489	1,626	1,765	1,906	2,048	2,193	2,340	2,489	2,640	2,792	2,947	3,104	3,262
32		679	822	967	1,114	1,263	1,415	1,569	1,725	1,883	2,044	2,207	2,372	2,539	2,709	2,880	3,054	3,231	3,409	3,590	3,773
34			943	1,109	1,278	1,449	1,623	1,799	1,978	2,159	2,343	2,529	2,718	2,910	3,104	3,300	3,499	3,701	3,905	4,112	4,321
36			1,073	1,261	1,453	1,647	1,845	2,045	2,248	2,454	2,662	2,874	3,088	3,305	3,525	3,748	3,974	4,203	4,434	4,668	4,905
38				1,423	1,639	1,858	2,081	2,306	2,535	2,767	3,002	3,240	3,481	3,726	3,974	4,224	4,479	4,736	4,996	5,260	5,526
40				1,595	1,836	2,082	2,331	2,583	2,839	3,099	3,361	3,628	3,898	4,171	4,448	4,729	5,013	5,301	5,592	5,886	6,184
42				1,776	2,045	2,318	2,595	2,876	3,160	3,449	3,741	4,038	4,338	4,642	4,950	5,262	5,577	5,897	6,220	6,548	6,879
44				1,967	2,264	2,567	2,873	3,184	3,499	3,818	4,141	4,469	4,801	5,137	5,478	5,822	6,171	6,525	6,882	7,244	7,610
46				2,167	2,495	2,828	3,165	3,507	3,854	4,206	4,562	4,922	5,288	5,658	6,032	6,412	6,795	7,184	7,577	7,975	8,378
48				2,377	2,737	3,102	3,472	3,847	4,227	4,612	5,002	5,397	5,798	6,203	6,613	7,029	7,449	7,875	8,306	8,741	9,182
50				2,597	2,990	3,388	3,792	4,201	4,616	5,037	5,463	5,894	6,331	6,773	7,221	7,674	8,133	8,597	9,067	9,543	10,023
52						3,687	4,126	4,572	5,023	5,480	5,943	6,412	6,887	7,368	7,855	8,348	8,847	9,352	9,862	10,379	10,901
54						3,999	4,475	4,958	5,447	5,942	6,444	6,953	7,467	7,988	8,516	9,050	9,590	10,137	10,690	11,250	11,816
56						4,323	4,837	5,359	5,888	6,423	6,965	7,514	8,071	8,634	9,203	9,780	10,364	10,954	11,552	12,156	12,767
58						4,659	5,214	5,776	6,346	6,922	7,507	8,098	8,697	9,304	9,917	10,538	11,167	11,803	12,446	13,097	13,755
60						5,009	5,605	6,209	6,821	7,440	8,063	8,704	9,347	9,998	10,658	11,325	12,000	12,683	13,374	14,073	14,780
62									7,313	7,977	8,650	9,331	10,020	10,718	11,425	12,140	12,863	13,595	14,335	15,084	15,841
64									7,822	8,532	9,251	9,980	10,717	11,463	12,218	12,983	13,756	14,538	15,330	16,130	16,939
66									8,348	9,106	9,873	10,650	11,437	12,233	13,039	13,854	14,679	15,513	16,357	17,211	18,074
68									8,891	9,698	10,515	11,343	12,180	13,028	13,885	14,753	15,631	16,520	17,418	18,326	19,245
70									9,452	10,309	11,178	12,057	12,947	13,847	14,759	15,681	16,614	17,558	18,512	19,477	20,453
72											11,860	12,793	13,737	14,692	15,659	16,637	17,626	18,627	19,639	20,663	21,698
74											12,563	13,550	14,550	15,561	16,585	17,621	18,668	19,728	20,800	21,884	22,980
76											13,286	14,330	15,386	16,456	17,538	18,633	19,741	20,861	21,994	23,139	24,298
78											14,029	15,131	16,246	17,375	18,518	19,673	20,843	22,025	23,221	24,430	25,653
80											14,792	15,954	17,130	18,320	19,524	20,742	21,974	23,221	24,481	25,756	27,044

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Table 6.—Board-foot volume of ponderosa and Jeffrey pine by Scribner rule in 16-foot logs to a utilized top

Diameter breast height outside bark--inches [1]	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
12	[2]23	27	33	40	51	62	73	84	95	106	117	129	140								
14		45	63	81	99	116	134	152	170	188	206	224	242								
16		79	106	132	158	184	210	236	262	288	314	340	367								
18		121	157	192	228	264	300	335	371	407	442	478	514								
20	123	170	216	263	310	357	403	450	497	544	590	637	684	730	777	824					
22	166	225	285	344	403	462	521	580	639	699	758	817	876	935	994	1,053					
24	215	288	361	434	507	580	653	726	799	872	945	1,018	1,091	1,164	1,237	1,310					
26	270	358	446	534	623	711	799	887	976	1,064	1,152	1,240	1,328	1,417	1,505	1,593					
28		435	540	645	749	854	959	1,064	1,169	1,274	1,379	1,484	1,588	1,693	1,798	1,903					
30		519	642	765	888	1,010	1,133	1,256	1,379	1,502	1,625	1,748	1,871	1,994	2,117	2,240	2,363	2,486	2,608	2,731	2,854
32		610	752	895	1,037	1,179	1,322	1,464	1,606	1,749	1,891	2,034	2,176	2,318	2,461	2,603	2,746	2,888	3,030	3,173	3,315
34			871	1,034	1,198	1,361	1,524	1,687	1,851	2,014	2,177	2,340	2,504	2,667	2,830	2,993	3,157	3,320	3,483	3,647	3,810
36			998	1,184	1,369	1,555	1,741	1,926	2,112	2,297	2,483	2,668	2,854	3,039	3,225	3,411	3,596	3,782	3,967	4,153	4,338
38				1,343	1,553	1,762	1,971	2,180	2,390	2,599	2,808	3,017	3,227	3,436	3,645	3,854	4,064	4,273	4,482	4,691	4,901
40				1,513	1,747	1,981	2,216	2,450	2,684	2,919	3,153	3,388	3,622	3,856	4,091	4,325	4,559	4,794	5,028	5,262	5,497
42				1,692	1,953	2,214	2,475	2,735	2,996	3,257	3,518	3,779	4,040	4,301	4,561	4,822	5,083	5,344	5,605	5,866	6,127
44				1,881	2,170	2,459	2,747	3,036	3,325	3,614	3,902	4,191	4,480	4,769	5,058	5,346	5,635	5,924	6,213	6,502	6,790
46				2,080	2,398	2,716	3,034	3,352	3,671	3,989	4,307	4,625	4,943	5,261	5,579	5,897	6,215	6,534	6,852	7,170	7,488
48				2,289	2,638	2,986	3,335	3,684	4,033	4,382	4,731	5,080	5,428	5,777	6,126	6,475	6,824	7,173	7,522	7,870	8,219
50				2,507	2,888	3,269	3,650	4,031	4,412	4,793	5,174	5,555	5,936	6,317	6,698	7,079	7,460	7,841	8,222	8,603	8,984
52						3,565	3,980	4,394	4,809	5,223	5,638	6,052	6,467	6,882	7,296	7,711	8,125	8,540	8,954	9,369	9,784
54						3,873	4,323	4,772	5,222	5,671	6,121	6,571	7,020	7,470	7,919	8,369	8,818	9,268	9,717	10,167	10,616
56						4,194	4,680	5,166	5,652	6,138	6,624	7,110	7,596	8,082	8,568	9,053	9,539	10,025	10,511	10,997	11,483
58						4,528	5,052	5,575	6,099	6,623	7,147	7,670	8,194	8,718	9,241	9,765	10,289	10,812	11,336	11,860	12,383
60						4,874	5,437	6,000	6,563	7,126	7,689	8,252	8,815	9,378	9,940	10,503	11,066	11,629	12,192	12,755	13,318
62									7,044	7,647	8,251	8,854	9,458	10,061	10,665	11,268	11,872	12,475	13,079	13,682	14,286
64									7,542	8,187	8,833	9,478	10,124	10,769	11,415	12,060	12,706	13,351	13,997	14,642	15,288
66									8,056	8,745	9,434	10,123	10,812	11,501	12,190	12,879	13,568	14,257	14,946	15,635	16,324
68									8,588	9,322	10,055	10,789	11,523	12,257	12,991	13,724	14,458	15,192	15,926	16,659	17,393
70									9,136	9,916	10,696	11,476	12,256	13,036	13,816	14,596	15,376	16,156	16,936	17,716	18,496
72											11,357	12,185	13,012	13,840	14,668	15,495	16,323	17,151	17,978	18,806	19,634
74											12,038	12,914	13,791	14,668	15,544	16,421	17,298	18,175	19,051	19,928	20,805
76											12,738	13,665	14,592	15,519	16,446	17,374	18,301	19,228	20,155	21,082	22,010
78											13,458	14,437	15,416	16,395	17,374	18,353	19,332	20,311	21,290	22,269	23,248
80											14,197	15,230	16,262	17,294	18,327	19,359	20,391	21,424	22,456	23,488	24,521

[1] Diameter classes are midpoint; e.g. 12-inch class includes 11.0-12.9.

NOTE.--Block indicates extent of data.

[2] The volume of a tree with a minimum saw log 8 inches d.i.b. and 12 feet long is 23 board feet. Trees lacking this minimum saw log have no Scribner volume.

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Table 7.—Cubic-foot volume of sugar pine

Diameter breast height outside bark-- inches 1/	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
6	2	3	4	4	5	5	6	6	7	8	8	9	9								
8	4	5	6	7	8	9	10	12	13	14	15	16	17								
10	7	8	10	12	14	15	17	19	20	22	24	25	27								
12	10	12	15	17	20	22	25	27	30	32	35	37	40								
14	14	17	21	24	28	31	35	38	42	45	48	52	55								
16	18	23	27	32	37	41	46	50	55	60	64	69	73								
18	23	29	35	41	47	53	59	64	70	76	82	88	94								
20	29	36	44	51	58	66	73	80	87	95	102	109	117	124	131	139					
22	36	44	53	62	71	80	89	98	107	115	124	133	142	151	160	169					
24	43	53	64	74	85	96	106	117	128	138	149	159	170	181	191	202					
26	50	63	75	88	100	113	125	138	150	163	175	188	200	213	225	238					
28		73	88	102	117	131	146	160	175	190	204	219	233	248	263	277					
30		84	101	118	134	151	168	185	202	218	235	252	269	286	302	319	336	353	370	386	403
32		96	115	134	153	173	192	211	230	249	268	288	307	326	345	364	383	403	422	441	460
34			130	152	174	195	217	239	260	282	304	326	347	369	391	412	434	456	477	499	521
36			146	171	195	219	244	268	293	317	341	366	390	415	439	463	488	512	536	561	585
38				191	218	245	272	299	327	354	381	408	436	463	490	517	545	572	599	626	653
40				212	242	272	302	332	363	393	423	453	484	514	544	574	604	635	665	695	725
42				234	267	300	334	367	401	434	467	501	534	567	601	634	668	701	734	768	801
44				257	294	330	367	404	440	477	514	550	587	624	660	697	734	770	807	844	881
46				281	321	361	402	442	482	522	562	602	642	683	723	763	803	843	883	924	964
48				306	350	394	438	482	525	569	613	657	700	744	788	832	876	919	963	1,007	1,051
50				333	380	428	476	523	571	618	666	713	761	808	856	904	951	999	1,046	1,094	1,141
52						463	515	566	618	669	721	772	824	875	927	978	1,030	1,081	1,133	1,184	1,236
54						500	556	611	667	723	778	834	889	945	1,001	1,056	1,112	1,167	1,223	1,279	1,334
56						539	598	658	718	778	838	898	957	1,017	1,077	1,137	1,197	1,257	1,316	1,376	1,436
58						578	642	707	771	835	899	964	1,028	1,092	1,156	1,221	1,285	1,349	1,413	1,478	1,542
60						619	688	757	826	894	963	1,032	1,101	1,170	1,238	1,307	1,376	1,445	1,514	1,582	1,651
62									882	956	1,029	1,103	1,176	1,250	1,323	1,397	1,470	1,544	1,617	1,691	1,765
64									941	1,019	1,098	1,176	1,254	1,333	1,411	1,490	1,568	1,646	1,725	1,803	1,882
66									1,001	1,085	1,168	1,251	1,335	1,418	1,502	1,585	1,669	1,752	1,835	1,919	2,002
68									1,063	1,152	1,241	1,329	1,418	1,506	1,595	1,684	1,772	1,861	1,950	2,038	2,127
70									1,128	1,221	1,315	1,409	1,503	1,597	1,691	1,785	1,879	1,973	2,067	2,161	2,255
72											1,392	1,492	1,591	1,691	1,790	1,890	1,989	2,089	2,188	2,288	2,387
74											1,472	1,577	1,682	1,787	1,892	1,997	2,102	2,207	2,313	2,418	2,523
76											1,553	1,664	1,775	1,886	1,997	2,108	2,219	2,330	2,440	2,551	2,662
78											1,637	1,754	1,870	1,987	2,104	2,221	2,338	2,455	2,572	2,689	2,806
80											1,722	1,845	1,968	2,091	2,214	2,338	2,461	2,584	2,707	2,830	2,953

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Table 8.—Board-foot volume of sugar pine by International 1/4-inch rule

Diameter breast height outside bark--inches [1]	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
10	21	27	34	40	48	55	64	73	83	94	106	119	133								
12	40	51	62	74	86	99	113	127	143	160	178	197	217								
14	64	80	98	115	134	153	174	195	218	241	266	293	321								
16	92	116	140	166	192	219	247	276	306	338	372	407	444								
18	125	158	191	224	259	295	332	370	410	451	494	539	586								
20	163	205	248	291	336	382	429	477	527	579	633	689	747	808	871	936					
22	206	259	312	367	422	479	538	598	660	723	789	857	928	1,001	1,077	1,156					
24	254	318	384	451	519	588	659	732	806	883	962	1,044	1,128	1,215	1,305	1,398					
26	306	384	463	543	625	707	792	879	967	1,058	1,152	1,248	1,347	1,449	1,555	1,663					
28		456	549	644	740	838	937	1,039	1,143	1,249	1,358	1,470	1,586	1,704	1,826	1,951					
30		533	643	753	865	979	1,095	1,213	1,333	1,456	1,582	1,711	1,843	1,979	2,119	2,262	2,410	2,562	2,719	2,881	3,048
32		617	743	871	1,000	1,131	1,264	1,399	1,537	1,678	1,822	1,969	2,120	2,275	2,433	2,596	2,763	2,935	3,112	3,294	3,482
34			851	997	1,144	1,293	1,445	1,599	1,756	1,916	2,079	2,246	2,416	2,591	2,770	2,953	3,141	3,334	3,532	3,736	3,945
36			966	1,131	1,298	1,467	1,638	1,813	1,990	2,170	2,353	2,541	2,732	2,927	3,127	3,332	3,542	3,757	3,978	4,205	4,437
38				1,274	1,462	1,652	1,844	2,039	2,237	2,439	2,644	2,853	3,067	3,284	3,507	3,735	3,968	4,206	4,451	4,701	4,958
40				1,425	1,635	1,847	2,061	2,279	2,499	2,724	2,952	3,184	3,421	3,662	3,908	4,160	4,417	4,680	4,950	5,225	5,508
42				1,585	1,818	2,053	2,291	2,532	2,776	3,024	3,276	3,533	3,794	4,060	4,331	4,608	4,891	5,180	5,475	5,777	6,087
44				1,753	2,010	2,270	2,532	2,798	3,067	3,340	3,618	3,900	4,186	4,478	4,776	5,079	5,389	5,705	6,027	6,357	6,694
46				1,930	2,212	2,498	2,786	3,077	3,373	3,672	3,976	4,285	4,598	4,917	5,242	5,573	5,910	6,255	6,606	6,965	7,331
48				2,115	2,424	2,736	3,051	3,370	3,693	4,020	4,351	4,688	5,029	5,377	5,730	6,090	6,456	6,830	7,211	7,600	7,996
50				2,308	2,646	2,986	3,329	3,676	4,027	4,383	4,743	5,109	5,480	5,857	6,240	6,629	7,026	7,430	7,842	8,262	8,691
52						3,246	3,619	3,995	4,376	4,762	5,152	5,548	5,949 .	6,357	6,771	7,192	7,620	8,056	8,500	8,953	9,414
54						3,517	3,920	4,328	4,739	5,156	5,578	6,005	6,438	6,878	7,324	7,777	8,238	8,707	9,185	9,671	10,166
56						3,799	4,234	4,673	5,117	5,566	6,020	6,480	6,946	7,419	7,899	8,386	8,881	9,384	9,896	10,417	10,947
58						4,092	4,560	5,032	5,509	5,992	6,479	6,973	7,473	7,890	8,495	9,017	9,547	10,086	10,633	11,190	11,757
60						4,395	4,898	5,404	5,916	6,433	6,956	7,485	8,020	8,563	9,113	9,671	10,237	10,812	11,397	11,991	12,596
62									6,337	6,890	7,449	8,014	8,586	9,165	9,752	10,348	10,952	11,565	12,187	12,820	13,463
64									6,773	7,363	7,959	8,561	9,171	9,788	10,414	11,047	11,690	12,342	13,004	13,677	14,360
66									7,223	7,851	8,485	9,127	9,775	10,432	11,097	11,770	12,453	13,145	13,848	14,561	15,285
68									7,687	8,355	9,029	9,710	10,399	11,096	11,801	12,516	13,239	13,973	14,718	15,473	16,240
70									8,166	8,874	9,590	10,312	11,042	11,780	12,527	13,284	14,050	14,827	15,614	16,413	17,223
72											10,167	10,932	11,704	12,485	13,275	14,075	14,885	15,705	16,537	17,380	18,235
74											10,761	11,569	12,386	13,211	14,045	14,889	15,744	16,609	17,486	18,375	19,276
76											11,372	12,225	13,086	13,957	14,836	15,726	16,627	17,538	18,462	19,397	20,346
78											12,000	12,899	13,806	14,723	15,649	16,586	17,534	18,493	19,464	20,448	21,445
80											12,645	13,591	14,546	15,510	16,484	17,469	18,465	19,473	20,493	21,526	22,573

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Step indicates extent of data.

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Table 9.—Board-foot volume of sugar pine by Scribner rule in 16-foot logs to a utilized top

Diameter breast height outside bark--inches[1]	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
12	25	31	37	43	49	55	61	67	74	80	86	92	98								
14	46	58	69	81	92	104	116	127	139	150	162	173	185								
16	73	91	109	128	146	164	182	201	219	237	255	274	292								
18	105	131	157	183	210	236	262	288	314	341	367	393	419								
20	142	177	212	248	283	319	354	389	425	460	496	531	566	602	637	673					
22	183	229	275	321	367	413	459	505	550	596	642	688	734	780	826	872					
24	230	288	346	403	461	518	576	634	691	749	806	864	922	979	1,037	1,094					
26	282	353	424	494	565	635	706	777	847	918	988	1,059	1,129	1,200	1,271	1,341					
28		424	509	594	679	764	848	933	1,018	1,103	1,188	1,273	1,357	1,442	1,527	1,612					
30		502	602	702	803	903	1,003	1,104	1,204	1,305	1,405	1,505	1,606	1,706	1,806	1,907	2,007	2,107	2,208	2,308	2,408
32		586	703	820	937	1,054	1,171	1,288	1,405	1,522	1,640	1,757	1,874	1,991	2,108	2,225	2,342	2,459	2,577	2,694	2,811
34			811	946	1,081	1,216	1,351	1,487	1,622	1,757	1,892	2,027	2,162	2,297	2,433	2,568	2,703	2,838	2,973	3,108	3,243
36			927	1,081	1,235	1,390	1,544	1,699	1,853	2,008	2,162	2,316	2,471	2,625	2,780	2,934	3,089	3,243	3,397	3,552	3,706
38				1,225	1,400	1,575	1,750	1,925	2,100	2,275	2,450	2,625	2,800	2,975	3,150	3,325	3,500	3,675	3,849	4,024	4,199
40				1,377	1,574	1,771	1,968	2,165	2,361	2,558	2,755	2,952	3,149	3,345	3,542	3,739	3,936	4,132	4,329	4,526	4,723
42				1,539	1,759	1,979	2,198	2,418	2,638	2,858	3,078	3,298	3,518	3,737	3,957	4,177	4,397	4,617	4,837	5,057	5,276
44				1,709	1,953	2,198	2,442	2,686	2,930	3,174	3,418	3,663	3,907	4,151	4,395	4,639	4,883	5,128	5,372	5,616	5,860
46				1,888	2,158	2,428	2,698	2,967	3,237	3,507	3,777	4,046	4,316	4,586	4,856	5,125	5,395	5,665	5,935	6,204	6,474
48				2,076	2,373	2,669	2,966	3,263	3,559	3,856	4,152	4,449	4,746	5,042	5,339	5,636	5,932	6,229	6,525	6,822	7,119
50				2,273	2,598	2,922	3,247	3,572	3,887	4,221	4,546	4,871	5,195	5,520	5,845	6,170	6,494	6,819	7,144	7,468	7,793
52						3,187	3,541	3,895	4,249	4,603	4,957	5,311	5,665	6,019	6,373	6,727	7,082	7,436	7,790	8,144	8,498
54						3,462	3,847	4,232	4,616	5,001	5,386	5,770	6,155	6,540	6,925	7,309	7,694	8,079	8,463	8,848	9,233
56						3,749	4,166	4,582	4,999	5,416	5,832	6,249	6,665	7,082	7,499	7,915	8,332	8,748	9,165	9,581	9,998
58						4,048	4,497	4,947	5,397	5,846	6,296	6,746	7,196	7,645	8,095	8,545	8,995	9,444	9,894	10,344	10,793
60						4,357	4,841	5,325	5,810	6,294	6,778	7,262	7,746	8,230	8,714	9,199	9,683	10,167	10,651	11,135	11,619
62									6,238	6,757	7,277	7,797	8,317	8,837	9,356	9,876	10,396	10,916	11,435	11,955	12,475
64									6,681	7,237	7,794	8,351	8,907	9,464	10,021	10,578	11,134	11,691	12,248	12,805	13,361
66									7,139	7,734	8,329	8,924	9,518	10,113	10,708	11,303	11,898	12,493	13,088	13,683	14,278
68									7,612	8,246	8,881	9,515	10,149	10,784	11,418	12,053	12,687	13,321	13,956	14,590	15,224
70									8,101	8,776	9,451	10,126	10,801	11,476	12,151	12,826	13,501	14,176	14,851	15,526	16,201
72											10,038	10,755	11,472	12,189	12,906	13,623	14,340	15,057	15,774	16,491	17,208
74											10,643	11,403	12,164	12,924	13,684	14,444	15,205	15,965	16,725	17,485	18,246
76											11,266	12,071	12,875	13,680	14,485	15,290	16,094	16,899	17,704	18,508	19,313
78											11,906	12,757	13,607	14,458	15,308	16,159	17,009	17,859	18,710	19,560	20,411
80											12,564	13,462	14,359	15,257	16,154	17,052	17,949	18,847	19,744	20,641	21,539

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 10.—Cubic-foot volume of lodgepole pine

Diameter breast height outside bark-- inches[1]	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
6	3	4	5	5	6	6	6						
8	6	7	8	9	10	11	12						
10	9	11	13	15	17	18	20	21	22	23	23	25	26
12	13	16	19	22	25	27	29	31	33	34	35	36	38
14	17	21	26	30	34	37	41	43	46	48	50	52	53
16	22	28	34	39	44	49	54	58	62	65	68	71	73
18	28	35	42	49	57	63	69	74	79	84	88	92	95
20	35	44	52	61	70	78	86	93	99	105	111	116	120
22	42	53	63	74	84	95	104	113	121	129	136	143	148
24	50	63	75	88	101	113	125	135	146	155	164	172	180
26	59	74	88	103	118	133	147	160	172	184	194	204	214
28		86	103	120	137	154	171	186	201	214	227	240	251
30		98	118	137	157	177	196	215	232	248	263	277	291
32		112	134	156	179	201	223	245	265	283	301	318	334
34			151	177	202	227	252	277	300	322	342	361	380
36			170	198	226	254	283	311	338	362	385	408	429
38				221	252	284	315	347	378	405	431	457	481
40				244	279	314	349	384	419	450	480	508	536
42				269	308	346	385	423	462	498	531	563	593
44				296	338	380	422	465	507	548	585	620	654
46				323	369	415	462	508	554	600	641	680	718
48				352	402	452	503	553	603	653	700	743	784
50				382	436	491	545	600	654	709	761	808	854

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 11.—Board-foot volume of lodgepole pine by International 1/4-inch rule

Stump and top excluded

Diameter breast height outside bark-- inches[1]	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
10	23	39	55	70	86	101	117						
12	43	66	88	110	133	155	178	200	223	245	268	290	313
14	68	98	129	159	190	221	251	282	312	343	374	404	435
16	97	137	177	217	257	297	337	377	417	457	497	537	577
18	132	183	233	284	334	385	436	486	537	587	638	688	739
20	172	234	297	359	421	484	546	609	671	734	796	859	921
22	216	292	367	443	519	594	670	745	821	896	972	1,048	1,123
24	266	356	446	536	626	716	805	895	985	1,075	1,165	1,255	1,345
26	321	426	532	637	743	848	954	1,059	1,165	1,270	1,376	1,482	1,587
28		503	625	747	870	992	1,115	1,237	1,359	1,482	1,604	1,727	1,849
30		585	726	866	1,007	1,147	1,288	1,428	1,569	1,709	1,850	1,990	2,131
32		674	834	994	1,154	1,314	1,474	1,634	1,793	1,953	2,113	2,273	2,433
34			950	1,131	1,311	1,491	1,672	1,852	2,033	2,213	2,394	2,574	2,755
36			1,073	1,276	1,478	1,680	1,883	2,085	2,287	2,490	2,692	2,894	3,097
38				1,430	1,655	1,881	2,106	2,331	2,557	2,782	3,008	3,233	3,459
40				1,592	1,842	2,092	2,342	2,592	2,841	3,091	3,341	3,591	3,841
42				1,764	2,039	2,315	2,590	2,865	3,141	3,416	3,692	3,967	4,242
44				1,944	2,246	2,548	2,851	3,153	3,455	3,757	4,060	4,362	4,664
46				2,133	2,463	2,794	3,124	3,454	3,785	4,115	4,445	4,776	5,106
48				2,330	2,690	3,050	3,410	3,769	4,129	4,489	4,848	5,208	5,568
50				2,537	2,927	3,317	3,708	4,098	4,488	4,879	5,269	5,659	6,050

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 12.—*Board-foot volume of lodgepole pine by Scribner rule in 16-foot logs to a utilized top*

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark-- inches [1]	Total height--Feet												
	40	50	60	70	80	90	100	110	120	130	140	150	160
12	27	48	68	89	110	130	151	172	192	213	234	254	275
14	48	76	104	132	160	188	216	244	272	301	329	357	385
16	73	109	146	183	220	256	293	330	367	403	440	477	513
18	102	149	195	242	288	335	381	428	474	521	567	614	660
20	137	194	252	309	366	424	481	538	596	653	711	768	825
22	176	245	315	384	453	523	592	662	731	801	870	940	1,009
24	219	302	384	467	550	632	715	798	880	963	1,046	1,128	1,211
26	267	364	461	558	655	752	849	946	1,043	1,140	1,237	1,334	1,431
28		432	545	657	770	882	995	1,107	1,220	1,332	1,445	1,557	1,670
30		506	636	765	894	1,023	1,152	1,281	1,410	1,539	1,669	1,798	1,927
32		586	733	880	1,027	1,174	1,321	1,468	1,615	1,761	1,908	2,055	2,202
34			837	1,003	1,169	1,335	1,501	1,667	1,832	1,998	2,164	2,330	2,496
36			949	1,135	1,320	1,506	1,692	1,878	2,064	2,250	2,436	2,622	2,808
38				1,274	1,481	1,688	1,895	2,103	2,310	2,517	2,724	2,931	3,138
40				1,421	1,651	1,880	2,110	2,340	2,569	2,799	3,028	3,258	3,487
42				1,577	1,830	2,083	2,336	2,589	2,842	3,095	3,348	3,601	3,854
44				1,740	2,018	2,296	2,573	2,851	3,129	3,407	3,684	3,962	4,240
46				1,912	2,215	2,519	2,822	3,126	3,430	3,733	4,037	4,340	4,644
48				2,091	2,422	2,752	3,083	3,413	3,744	4,075	4,405	4,736	5,066
50				2,279	2,637	2,996	3,355	3,713	4,072	4,431	4,789	5,148	5,507

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 13.—Cubic-foot volume of white fir

Diameter breast height outside bark-- inches 1/	Total height--Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
6	3	3	4	5	5	6	7	7	8	9	9	10	10								
8	5	6	7	8	10	11	12	13	14	15	16	17	19								
10	8	9	11	13	15	17	18	20	22	24	26	27	29								
12	11	14	16	19	21	24	27	29	32	34	37	39	42								
14	15	18	22	26	29	33	36	40	43	47	50	54	57								
16	19	24	29	33	38	43	47	52	56	61	65	70	74								
18	24	30	36	42	48	54	60	66	71	77	83	89	94								
20	30	38	45	52	60	67	74	81	88	95	102	109	116	123	130	137					
22	36	45	54	63	72	81	90	98	107	115	124	132	141	149	157	165					
24	43	54	65	75	86	96	107	117	127	137	147	157	167	177	187	197					
26	51	63	76	88	101	113	125	137	149	161	173	185	196	208	220	231					
28		74	88	102	117	131	145	159	173	187	200	214	228	241	255	268					
30		84	101	118	134	150	166	183	198	214	230	246	261	277	292	308	323	338	353	368	382
32		96	115	134	152	171	189	208	226	244	262	280	297	315	333	350	367	384	401	418	435
34			130	151	172	193	214	234	255	275	296	316	336	356	375	395	415	434	453	472	491
36			146	169	193	216	240	263	286	309	331	354	376	399	421	443	465	486	508	529	551
38				189	215	241	267	293	318	344	369	394	419	444	469	493	518	542	566	590	614
40				209	238	267	296	324	353	381	409	437	465	492	520	547	574	601	627	654	680
42				230	263	294	326	358	389	420	451	482	512	543	573	603	633	662	691	721	750
44				253	288	323	358	393	427	461	495	529	562	596	629	662	694	727	759	791	823
46				276	315	353	391	429	467	504	541	578	615	651	687	723	759	794	829	864	899
48				301	343	385	426	467	508	549	589	629	669	709	748	787	826	865	903	941	979
50				327	372	417	462	507	551	596	639	683	726	769	812	854	896	938	980	1,021	1,062
52						451	500	548	596	644	692	739	785	832	878	924	970	1,015	1,060	1,105	1,149
54						487	539	591	643	695	746	797	847	897	947	996	1,046	1,094	1,143	1,191	1,239
56						524	580	636	692	747	802	857	911	965	1,018	1,072	1,125	1,177	1,229	1,281	1,332
58						562	622	682	742	801	860	919	977	1,035	1,092	1,150	1,206	1,263	1,319	1,374	1,429
60						601	666	730	794	858	921	983	1,046	1,108	1,169	1,230	1,291	1,351	1,411	1,471	1,530
62									848	916	983	1,050	1,117	1,183	1,248	1,314	1,378	1,443	1,507	1,570	1,633
64									903	976	1,048	1,119	1,190	1,260	1,330	1,400	1,469	1,537	1,605	1,673	1,740
66									961	1,038	1,114	1,190	1,265	1,340	1,415	1,489	1,562	1,635	1,707	1,779	1,851
68									1,020	1,101	1,183	1,263	1,343	1,423	1,502	1,580	1,658	1,736	1,812	1,889	1,965
70									1,081	1,167	1,253	1,338	1,423	1,508	1,591	1,674	1,757	1,839	1,921	2,002	2,082
72											1,326	1,416	1,506	1,595	1,684	1,771	1,859	1,946	2,032	2,118	2,203
74											1,400	1,496	1,591	1,685	1,778	1,871	1,964	2,055	2,146	2,237	2,327
76											1,477	1,578	1,678	1,777	1,876	1,974	2,071	2,168	2,264	2,359	2,454
78											1,556	1,662	1,767	1,872	1,976	2,079	2,182	2,283	2,385	2,485	2,585
80											1,637	1,748	1,859	1,969	2,078	2,187	2,295	2,402	2,509	2,614	2,719

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 14.—Board-foot volume of white fir by International 1/4-inch rule

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Diameter breast height outside bark— inches [1/]	Total height—Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
10	33	38	42	45	50	57	68	84	107	137	177	226	288								
12	56	66	75	83	92	103	119	140	169	207	255	316	390								
14	84	102	116	130	144	161	182	210	245	291	349	420	507								
16	118	144	166	186	207	230	258	292	335	389	457	539	639								
18	157	193	224	253	281	311	346	388	439	502	579	673	785								
20	201	249	290	328	365	404	446	496	556	628	716	821	947	1,096	1,271	1,475					
22	251	312	365	413	460	508	559	618	687	769	867	984	1,123	1,287	1,479	1,702					
24	306	382	448	508	566	623	685	753	832	924	1,033	1,162	1,314	1,493	1,702	1,944					
26	367	459	539	612	682	751	823	901	990	1,093	1,214	1,355	1,520	1,714	1,940	2,200					
28		542	639	726	808	889	973	1,063	1,163	1,277	1,408	1,562	1,741	1,950	2,192	2,471					
30		633	747	849	946	1,040	1,135	1,237	1,348	1,474	1,618	1,784	1,977	2,201	2,459	2,756	3,097	3,485	3,924	4,419	4,974
32		730	863	982	1,094	1,202	1,310	1,424	1,548	1,686	1,842	2,021	2,228	2,466	2,741	3,056	3,417	3,828	4,292	4,815	5,401
34			987	1,125	1,253	1,375	1,498	1,625	1,761	1,911	2,080	2,273	2,493	2,746	3,037	3,371	3,752	4,184	4,673	5,224	5,841
36			1,120	1,276	1,422	1,561	1,698	1,839	1,988	2,151	2,333	2,539	2,773	3,042	3,349	3,700	4,100	4,555	5,068	5,646	6,293
38				1,438	1,602	1,757	1,910	2,066	2,229	2,405	2,601	2,820	3,068	3,352	3,675	4,044	4,463	4,939	5,476	6,080	6,756
40				1,609	1,792	1,966	2,135	2,306	2,483	2,674	2,883	3,116	3,378	3,676	4,016	4,402	4,840	5,337	5,897	6,527	7,232
42				1,789	1,993	2,186	2,372	2,559	2,751	2,956	3,179	3,426	3,703	4,016	4,371	4,774	5,231	5,748	6,332	6,987	7,719
44				1,979	2,205	2,417	2,622	2,825	3,033	3,253	3,490	3,751	4,043	4,371	4,741	5,161	5,637	6,174	6,779	7,459	8,219
46				2,179	2,427	2,660	2,884	3,104	3,329	3,563	3,815	4,091	4,397	4,740	5,126	5,563	6,057	6,613	7,240	7,944	8,731
48				2,388	2,660	2,915	3,158	3,397	3,638	3,888	4,155	4,446	4,766	5,124	5,526	5,979	6,490	7,067	7,715	8,442	9,254
50				2,606	2,904	3,181	3,445	3,702	3,961	4,228	4,510	4,815	5,150	5,523	5,941	6,410	6,939	7,534	8,202	8,952	9,790
52						3,459	3,744	4,021	4,297	4,581	4,879	5,199	5,549	5,937	6,370	6,855	7,401	8,014	8,703	9,475	10,338
54						3,748	4,056	4,353	4,648	4,948	5,262	5,598	5,963	6,366	6,814	7,315	7,877	8,509	9,217	10,011	10,897
56						4,050	4,380	4,698	5,012	5,330	5,660	6,012	6,392	6,809	7,273	7,789	8,368	9,017	9,745	10,560	11,469
58						4,362	4,716	5,056	5,389	5,726	6,073	6,440	6,835	7,268	7,746	8,278	8,873	9,539	10,286	11,121	12,053
60						4,686	5,065	5,427	5,781	6,136	6,500	6,883	7,294	7,741	8,234	8,781	9,392	10,075	10,840	11,695	12,649
62									6,186	6,560	6,941	7,341	7,767	8,229	8,737	9,299	9,926	10,625	11,407	12,281	13,256
64									6,605	6,998	7,398	7,813	8,255	8,732	9,255	9,832	10,473	11,189	11,988	12,881	13,876
66									7,038	7,450	7,868	8,301	8,758	9,250	9,787	10,379	11,035	11,766	12,582	13,493	14,508
68									7,484	7,917	8,353	8,803	9,276	9,783	10,334	10,940	11,611	12,357	13,189	14,117	15,151
70									7,944	8,398	8,853	9,319	9,808	10,330	10,896	11,516	12,201	12,962	13,810	14,755	15,807
72											9,367	9,851	10,356	10,893	11,473	12,107	12,806	13,581	14,444	15,405	16,475
74											9,895	10,397	10,918	11,470	12,064	12,712	13,425	14,214	15,091	16,067	17,155
76											10,438	10,958	11,495	12,062	12,670	13,331	14,057	14,860	15,751	16,743	17,846
78											10,996	11,533	12,087	12,669	13,291	13,965	14,705	15,520	16,425	17,431	18,550
80											11,568	12,124	12,694	13,290	13,926	14,614	15,366	16,144	17,112	18,132	19,266

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Table 15.—Board-foot volume of white fir by Scribner rule in 16-foot logs to a utilized top

Diameter breast height outside bark—inches[1]	Total height—Feet																				
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240
12	50	53	55	58	62	68	79	96	119	151	192	243	307								
14	77	85	92	99	108	119	135	158	187	226	275	336	411								
16	109	124	137	150	164	181	203	232	269	315	373	444	530								
18	147	170	190	209	230	255	284	320	364	419	486	567	664								
20	190	222	250	278	307	339	376	420	473	537	614	705	813	939	1,086	1,255					
22	239	281	319	356	394	435	481	534	596	669	756	857	976	1,115	1,275	1,458					
24	293	346	395	443	491	542	598	661	733	816	913	1,025	1,155	1,306	1,478	1,675					
26	352	418	480	539	599	660	727	800	883	977	1,084	1,208	1,349	1,512	1,696	1,906					
28		497	572	644	716	790	868	953	1,047	1,152	1,271	1,405	1,559	1,732	1,929	2,152					
30		583	672	759	844	931	1,022	1,119	1,224	1,341	1,472	1,618	1,783	1,968	2,177	2,411	2,673	2,966	3,292	3,653	4,051
32		675	781	882	982	1,083	1,187	1,297	1,416	1,545	1,687	1,845	2,022	2,219	2,439	2,685	2,959	3,263	3,600	3,973	4,384
34			897	1,015	1,130	1,246	1,365	1,489	1,621	1,763	1,918	2,088	2,276	2,484	2,716	2,972	3,257	3,572	3,920	4,303	4,725
36			1,021	1,156	1,289	1,421	1,555	1,694	1,840	1,995	2,163	2,345	2,545	2,765	3,007	3,274	3,569	3,894	4,251	4,643	5,074
38				1,307	1,458	1,607	1,757	1,911	2,072	2,242	2,423	2,618	2,829	3,060	3,313	3,590	3,894	4,227	4,593	4,993	5,430
40				1,467	1,637	1,804	1,972	2,142	2,318	2,502	2,697	2,905	3,129	3,371	3,634	3,920	4,233	4,574	4,946	5,352	5,795
42				1,636	1,826	2,012	2,198	2,386	2,578	2,777	2,986	3,207	3,443	3,696	3,969	4,264	4,584	4,932	5,310	5,721	6,167
44				1,814	2,025	2,232	2,437	2,643	2,852	3,067	3,290	3,525	3,772	4,036	4,319	4,622	4,950	5,303	5,686	6,099	6,547
46				2,001	2,235	2,463	2,688	2,913	3,139	3,371	3,609	3,857	4,117	4,391	4,683	4,995	5,328	5,687	6,072	6,488	6,935
48				2,198	2,455	2,705	2,951	3,195	3,440	3,688	3,942	4,204	4,476	4,761	5,062	5,381	5,720	6,082	6,470	6,885	7,331
50				2,403	2,685	2,959	3,227	3,491	3,755	4,021	4,290	4,566	4,851	5,146	5,456	5,782	6,126	6,491	6,879	7,293	7,735
52						3,223	3,514	3,800	4,084	4,367	4,653	4,943	5,240	5,546	5,864	6,196	6,544	6,911	7,299	7,710	8,146
54						3,499	3,814	4,122	4,426	4,728	5,030	5,335	5,645	5,961	6,287	6,625	6,976	7,344	7,730	8,136	8,566
56						3,786	4,126	4,457	4,782	5,103	5,422	5,742	6,064	6,391	6,725	7,068	7,422	7,789	8,172	8,573	8,993
58						4,085	4,450	4,805	5,152	5,492	5,829	6,164	6,499	6,836	7,177	7,525	7,881	8,247	8,625	9,019	9,428
60						4,394	4,786	5,166	5,535	5,896	6,251	6,601	6,948	7,296	7,644	7,996	8,353	8,717	9,090	9,474	9,872
62									5,932	6,314	6,687	7,053	7,413	7,770	8,125	8,481	8,838	9,199	9,566	9,940	10,322
64									6,343	6,746	7,138	7,520	7,893	8,260	8,622	8,980	9,337	9,694	10,052	10,414	10,781
66									6,768	7,193	7,603	8,001	8,388	8,764	9,132	9,493	9,849	10,201	10,550	10,899	11,248
68									7,206	7,654	8,084	8,498	8,897	9,284	9,658	10,021	10,375	10,721	11,060	11,393	11,723
70									7,658	8,129	8,579	9,010	9,422	9,818	10,198	10,562	10,914	11,252	11,580	11,897	12,205
72											9,089	9,536	9,962	10,367	10,752	11,118	11,466	11,797	12,111	12,410	12,695
74											9,613	10,078	10,517	10,931	11,321	11,688	12,032	12,353	12,654	12,933	13,193
76											10,152	10,634	11,087	11,510	11,905	12,272	12,611	12,922	13,207	13,466	13,699
78											10,706	11,206	11,672	12,104	12,504	12,870	13,203	13,504	13,772	14,009	14,213
80											11,274	11,792	12,272	12,713	13,117	13,482	13,809	14,097	14,348	14,561	14,735

1/ Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.—Block indicates extent of data.

Table 16.—Cubic-foot volume of California red fir

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Diameter breast height outside bark--Inches [1]	Total height--Feet																
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
6	3	4	5	5	6	7	8	9	9	10	11	12	13				
8	5	7	8	10	11	13	14	15	17	18	20	21	22				
10	8	10	13	15	17	20	22	24	26	28	31	33	35				
12	10	14	18	22	25	28	31	35	38	41	44	47	50				
14	13	18	23	28	34	38	43	47	51	56	60	64	68				
16	17	22	28	35	42	49	56	61	67	73	78	84	89				
18	21	27	34	42	50	59	69	78	85	92	99	106	113				
20	26	33	41	50	60	70	81	93	105	113	122	131	140	148	157	166	
22	32	40	49	59	70	82	95	108	122	136	148	158	169	180	190	201	
24	38	47	57	69	82	95	110	125	140	157	174	188	201	214	226	239	
26	44	55	66	79	94	109	125	142	160	178	198	218	236	251	265	280	
28		64	77	90	107	124	142	161	181	201	223	245	268	291	308	325	
30		74	88	103	120	140	160	181	203	225	249	274	300	326	353	373	393
32		84	101	117	135	156	178	202	226	251	277	304	333	362	392	423	447
34			113	132	151	174	198	224	250	278	307	336	367	399	432	466	501
36			127	148	170	192	219	247	276	306	337	370	403	438	473	510	548
38				165	189	213	241	271	303	335	369	405	441	478	517	557	598
40				183	209	236	263	296	331	366	403	441	480	521	562	605	649
42				202	231	260	289	323	360	398	438	479	521	565	610	656	703
44				222	253	285	317	350	390	432	474	518	564	611	659	708	759
46				242	277	312	346	381	422	466	512	559	608	658	709	762	817
48				264	302	339	377	415	455	502	551	602	654	707	762	818	876
50				286	327	368	409	450	491	540	592	646	701	758	816	876	938
52						398	442	487	531	578	634	691	750	811	873	936	1,002
54						429	477	525	573	620	678	738	801	865	931	998	1,067
56						462	513	564	616	667	722	787	853	921	991	1,062	1,135
58						495	550	605	661	716	771	837	907	979	1,052	1,128	1,205
60						530	589	648	707	766	825	889	962	1,038	1,116	1,196	1,277
62									755	818	881	943	1,020	1,100	1,181	1,265	1,351
64									804	871	938	1,005	1,078	1,162	1,249	1,337	1,427
66									855	927	998	1,069	1,140	1,227	1,318	1,410	1,504
68									908	984	1,059	1,135	1,211	1,293	1,388	1,485	1,584
70									962	1,042	1,122	1,203	1,283	1,363	1,461	1,563	1,666
72											1,188	1,272	1,357	1,442	1,535	1,642	1,750
74											1,254	1,344	1,434	1,523	1,613	1,723	1,836
76											1,323	1,418	1,512	1,607	1,701	1,806	1,924
78											1,394	1,493	1,593	1,692	1,792	1,891	2,014
80											1,466	1,571	1,676	1,780	1,885	1,990	2,106

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

27

Table 17.—Board-foot volume of California red fir by International 1/4-inch rule

Stump and top excluded

Top diameter, 6.5 inches
Stump height, 1 foot

Diameter breast height outside bark--inches[1]	Total height--Feet																
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
10	38	51	66	84	105	129	157	189	227	269	318	372	433				
12	54	72	92	115	142	173	209	250	296	349	409	477	552				
14	73	95	121	150	184	223	267	317	374	438	511	591	681				
16	94	122	154	191	232	279	332	392	460	536	621	716	822				
18	117	153	192	236	285	341	404	474	554	642	741	851	973				
20	144	187	233	286	344	409	482	564	656	758	871	996	1,135	1,288	1,455	1,638	
22	173	224	279	340	408	483	568	661	766	881	1,010	1,152	1,308	1,479	1,667	1,872	
24	205	264	329	399	477	564	660	766	884	1,014	1,158	1,317	1,491	1,683	1,892	2,119	
26	240	308	382	463	552	650	758	878	1,010	1,155	1,316	1,492	1,686	1,897	2,128	2,379	
28		355	440	532	632	742	864	997	1,144	1,306	1,483	1,678	1,891	2,123	2,376	2,652	
30		406	502	605	718	841	976	1,124	1,286	1,465	1,660	1,873	2,107	2,361	2,637	2,937	3,262
32		460	567	683	809	946	1,095	1,258	1,437	1,632	1,846	2,079	2,333	2,610	2,910	3,235	3,587
34			637	766	905	1,056	1,220	1,400	1,595	1,809	2,041	2,295	2,571	2,870	3,195	3,546	3,926
36			711	853	1,007	1,173	1,353	1,549	1,762	1,994	2,246	2,521	2,819	3,142	3,492	3,870	4,278
38				946	1,114	1,296	1,492	1,705	1,936	2,188	2,461	2,757	3,078	3,425	3,801	4,207	4,644
40				1,043	1,226	1,424	1,638	1,869	2,119	2,390	2,684	3,003	3,347	3,720	4,122	4,556	5,023
42				1,144	1,344	1,559	1,790	2,040	2,310	2,602	2,918	3,259	3,628	4,026	4,456	4,918	5,415
44				1,251	1,468	1,700	1,950	2,219	2,509	2,822	3,160	3,525	3,919	4,344	4,801	5,293	5,821
46				1,362	1,596	1,847	2,116	2,405	2,716	3,051	3,412	3,802	4,221	4,673	5,159	5,681	6,241
48				1,477	1,730	2,000	2,289	2,598	2,931	3,289	3,674	4,088	4,534	5,013	5,528	6,081	6,674
50				1,598	1,870	2,159	2,468	2,799	3,154	3,535	3,945	4,385	4,858	5,365	5,910	6,494	7,120
52						2,324	2,654	3,007	3,385	3,790	4,225	4,691	5,192	5,729	6,304	6,921	7,580
54						2,495	2,847	3,223	3,624	4,054	4,515	5,008	5,537	6,104	6,710	7,359	8,053
56						2,673	3,047	3,446	3,872	4,327	4,814	5,335	5,893	6,490	7,129	7,811	8,540
58						2,856	3,254	3,677	4,127	4,608	5,123	5,672	6,260	6,888	7,559	8,276	9,041
60						3,045	3,467	3,914	4,391	4,899	5,441	6,019	6,637	7,297	8,001	8,753	9,554
62									4,662	5,198	5,768	6,376	7,025	7,718	8,456	9,243	10,081
64									4,942	5,505	6,105	6,744	7,424	8,150	8,923	9,746	10,622
66									5,230	5,822	6,451	7,121	7,834	8,593	9,401	10,261	11,176
68									5,526	6,147	6,807	7,509	8,255	9,048	9,892	10,790	11,744
70									5,830	6,481	7,172	7,906	8,686	9,515	10,395	11,331	12,325
72											7,547	8,314	9,128	9,993	10,911	11,885	12,920
74											7,931	8,732	9,581	10,482	11,438	12,452	13,528
76											8,324	9,160	10,045	10,983	11,977	13,032	14,149
78											8,727	9,598	10,519	11,495	12,529	13,624	14,784
80											9,139	10,046	11,004	12,019	13,093	14,229	15,432

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

28

Table 18.—Board-foot volume of California red fir by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark--inches[1]	Total height--Feet																
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200
12	24	41	60	81	105	133	164	199	239	284	334	390	452				
14	38	60	84	112	142	177	215	259	308	363	424	491	566				
16	54	82	113	147	185	227	274	327	385	451	523	603	692				
18	74	108	146	187	233	284	340	402	471	548	633	726	828				
20	96	138	183	232	287	346	412	485	565	654	752	859	976	1,105	1,245	1,398	
22	121	171	224	283	346	416	492	576	668	769	880	1,002	1,135	1,280	1,438	1,610	
24	149	207	270	337	411	491	578	674	779	894	1,019	1,156	1,305	1,468	1,644	1,836	
26	179	247	320	397	481	573	672	780	898	1,027	1,167	1,320	1,487	1,667	1,863	2,075	
28		290	373	462	557	661	772	894	1,026	1,169	1,325	1,495	1,679	1,878	2,094	2,327	
30		337	431	532	639	755	880	1,015	1,162	1,321	1,493	1,680	1,882	2,101	2,338	2,593	2,867
32		388	494	606	726	855	994	1,144	1,306	1,481	1,671	1,876	2,097	2,336	2,594	2,871	3,170
34			560	685	819	962	1,115	1,281	1,459	1,651	1,858	2,082	2,323	2,583	2,863	3,163	3,487
36			631	770	917	1,075	1,244	1,425	1,620	1,829	2,055	2,298	2,560	2,841	3,144	3,469	3,817
38				859	1,021	1,194	1,379	1,577	1,789	2,017	2,262	2,525	2,808	3,112	3,438	3,787	4,161
40				953	1,131	1,320	1,521	1,737	1,967	2,214	2,479	2,763	3,067	3,394	3,744	4,119	4,520
42				1,051	1,246	1,452	1,671	1,904	2,153	2,420	2,705	3,010	3,338	3,688	4,063	4,464	4,892
44				1,155	1,366	1,590	1,827	2,079	2,348	2,634	2,941	3,269	3,619	3,994	4,394	4,822	5,278
46				1,264	1,493	1,734	1,990	2,261	2,550	2,858	3,187	3,537	3,912	4,312	4,738	5,193	5,678
48				1,377	1,624	1,885	2,160	2,452	2,762	3,091	3,442	3,817	4,216	4,641	5,095	5,578	6,093
50				1,496	1,762	2,042	2,337	2,650	2,981	3,333	3,708	4,106	4,531	4,983	5,464	5,976	6,521
52						2,205	2,521	2,855	3,209	3,584	3,983	4,406	4,857	5,336	5,845	6,387	6,963
54						2,374	2,712	3,069	3,445	3,844	4,268	4,717	5,194	5,701	6,239	6,811	7,418
56						2,550	2,910	3,289	3,690	4,114	4,562	5,038	5,543	6,078	6,646	7,249	7,888
58						2,732	3,115	3,518	3,943	4,392	4,867	5,369	5,902	6,467	7,065	7,700	8,372
60						2,920	3,327	3,754	4,204	4,679	5,181	5,711	6,273	6,867	7,497	8,164	8,870
62									4,474	4,976	5,505	6,064	6,655	7,280	7,941	8,641	9,381
64									4,752	5,281	5,838	6,427	7,048	7,704	8,398	9,132	9,907
66									5,039	5,595	6,182	6,800	7,452	8,140	8,867	9,635	10,446
68									5,333	5,919	6,535	7,184	7,867	8,588	9,349	10,152	11,000
70									5,637	6,252	6,898	7,578	8,294	9,048	9,844	10,683	11,567
72											7,270	7,982	8,731	9,520	10,351	11,226	12,149
74											7,653	8,397	9,180	10,004	10,870	11,783	12,744
76											8,045	8,823	9,640	10,499	11,402	12,353	13,353
78											8,447	9,259	10,111	11,006	11,947	12,936	13,976
80											8,859	9,705	10,593	11,525	12,504	13,532	14,613

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 19.—Cubic-foot volume of incense-cedar

Stump and top excluded

Top diameter, 4 inches
Stump height, 1 foot

Diameter breast height outside bark-- inches[1]	Total height--Feet														
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
6	3	3	4	4	4	5	5	6	6	7	7	8	8		
8	5	5	6	7	8	9	9	10	11	12	13	14	15		
10	7	9	10	11	12	14	15	16	18	19	21	22	24		
12	11	12	14	16	18	19	21	23	25	28	30	32	34		
14	14	17	19	22	24	26	29	32	35	38	40	43	46		
16	19	22	25	28	31	35	38	41	45	49	53	57	60		
18	24	28	32	36	40	44	48	52	57	62	67	72	76		
20	29	34	39	44	49	54	59	65	71	77	82	88	94	100	106
22	36	42	47	53	59	65	71	78	86	93	100	107	114	121	128
24	42	49	57	64	71	78	85	93	102	110	119	127	136	144	153
26	50	58	66	75	83	91	100	110	119	129	139	149	159	169	179
28		67	77	87	96	106	116	127	139	150	162	173	185	196	208
30		77	88	99	110	122	133	146	159	172	186	199	212	225	239
32		88	100	113	126	138	151	166	181	196	211	226	241	256	271
34			113	128	142	156	170	187	204	221	238	255	272	289	306
36			127	143	159	175	191	210	229	248	267	286	305	324	344
38				159	177	195	213	234	255	276	298	319	340	361	383
40				177	196	216	236	259	283	306	330	353	377	401	424
42				195	217	238	260	286	312	338	364	390	416	442	468
44				214	238	261	285	314	342	371	399	428	456	485	513
46				234	260	286	312	343	374	405	436	467	499	530	561
48				254	283	311	340	373	407	441	475	509	543	577	611
50				276	307	338	368	405	442	479	515	552	589	626	663
52						365	399	438	478	518	557	597	637	677	717
54						394	430	472	515	558	601	644	687	730	773
56						424	462	508	554	600	647	693	739	785	831
58						454	496	545	594	644	694	743	793	842	892
60						486	531	583	636	689	742	795	848	901	954
62						519	567	623	679	736	793	849	906	962	1,019
64						553	604	664	724	784	844	905	965	1,025	1,086
66						588	642	706	770	834	898	962	1,026	1,091	1,155
68									817	885	953	1,021	1,090	1,158	1,226
70									866	938	1,010	1,082	1,155	1,227	1,299
72											1,069	1,145	1,221	1,298	1,374
74											1,129	1,210	1,290	1,371	1,452
76											1,191	1,276	1,361	1,446	1,531
78											1,254	1,344	1,434	1,523	1,613
80											1,319	1,414	1,508	1,602	1,696

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 20.—Board-foot volume of incense-cedar by International 1/4-inch rule

Stump and top excluded

Diameter breast height outside bark-- inches[1/]	Total height--Feet														
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
10	31	40	49	58	68	79	90	102	116	130	145	162	180		
12	45	57	70	84	98	113	130	147	166	187	209	233	259		
14	61	78	95	114	133	154	177	201	227	255	285	317	352		
16	80	102	125	149	174	201	231	262	296	332	372	414	460		
18	101	129	158	188	220	255	292	332	375	421	470	524	582		
20	125	159	195	232	272	315	360	410	462	519	581	647	718	795	877
22	151	192	235	281	329	381	436	496	560	629	703	783	869	962	1,061
24	180	229	280	334	392	453	519	590	666	748	836	932	1,034	1,144	1,263
26	212	269	329	392	460	532	609	692	782	878	982	1,093	1,214	1,343	1,483
28		312	381	455	533	617	707	803	906	1,018	1,138	1,268	1,408	1,558	1,719
30		358	438	522	612	708	811	922	1,041	1,169	1,307	1,456	1,616	1,788	1,974
32		407	498	594	696	806	923	1,049	1,184	1,330	1,487	1,656	1,838	2,035	2,246
34			562	671	786	910	1,042	1,184	1,337	1,501	1,678	1,870	2,075	2,297	2,535
36			630	752	882	1,020	1,168	1,327	1,498	1,683	1,882	2,096	2,327	2,575	2,842
38				838	982	1,136	1,301	1,479	1,670	1,875	2,097	2,335	2,592	2,869	3,167
40				928	1,088	1,259	1,442	1,638	1,850	2,078	2,323	2,588	2,873	3,179	3,509
42				1,024	1,200	1,388	1,590	1,806	2,040	2,291	2,561	2,853	3,167	3,505	3,869
44				1,123	1,317	1,523	1,745	1,983	2,238	2,514	2,811	3,131	3,476	3,847	4,246
46				1,228	1,439	1,665	1,907	2,167	2,447	2,748	3,072	3,422	3,799	4,204	4,641
48				1,337	1,567	1,813	2,076	2,359	2,664	2,992	3,345	3,726	4,136	4,578	5,053
50				1,451	1,700	1,967	2,253	2,560	2,890	3,246	3,630	4,043	4,488	4,967	5,483
52						2,128	2,437	2,769	3,126	3,511	3,926	4,373	4,855	5,373	5,930
54						2,294	2,628	2,986	3,371	3,787	4,234	4,716	5,235	5,794	6,395
56						2,468	2,826	3,211	3,626	4,072	4,553	5,072	5,630	6,231	6,877
58						2,647	3,032	3,445	3,889	4,368	4,884	5,441	6,039	6,684	7,377
60						2,833	3,244	3,686	4,162	4,675	5,227	5,822	6,463	7,153	7,895
62						3,025	3,464	3,936	4,444	4,992	5,581	6,217	6,901	7,638	8,430
64						3,223	3,691	4,194	4,736	5,319	5,947	6,624	7,354	8,139	8,983
66						3,428	3,926	4,461	5,036	5,657	6,325	7,045	7,820	8,655	9,553
68									5,346	6,005	6,714	7,478	8,302	9,188	10,141
70									5,665	6,363	7,115	7,925	8,797	9,736	10,746
72											7,527	8,384	9,307	10,300	11,369
74											7,951	8,856	9,831	10,881	12,009
76											8,387	9,341	10,370	11,477	12,667
78											8,834	9,840	10,923	12,089	13,343
80											9,293	10,351	11,490	12,717	14,036

[1/] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

31

Table 21.—Board-foot volume of incense-cedar by Scribner rule in 16-foot logs to a utilized top

Stump and top excluded

Top diameter, variable
Stump height, 1 foot

Diameter breast height outside bark-- inches[1]	Total height--Feet														
	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
12	27	33	40	46	53	60	66	73	80	86	93	99	106		
14	42	53	63	74	84	95	105	116	126	137	147	158	168		
16	61	76	91	106	122	137	152	167	182	198	213	228	243		
18	83	103	124	145	165	186	207	227	248	269	289	310	331		
20	108	135	162	189	216	242	269	296	323	350	377	404	431	458	485
22	136	170	204	238	272	306	340	374	408	442	476	510	544	578	612
24	167	209	251	293	335	377	419	460	502	544	586	628	670	712	754
26	202	253	303	354	404	455	505	556	606	657	707	758	808	859	909
28		300	360	420	480	540	600	660	720	780	839	899	959	1,019	1,079
30		351	421	491	562	632	702	772	842	913	983	1,053	1,123	1,193	1,264
32		406	487	569	650	731	812	894	975	1,056	1,137	1,219	1,300	1,381	1,462
34			558	651	745	838	931	1,024	1,117	1,210	1,303	1,396	1,489	1,582	1,675
36			634	740	846	951	1,057	1,163	1,268	1,374	1,480	1,585	1,691	1,797	1,903
38				834	953	1,072	1,191	1,310	1,429	1,548	1,668	1,787	1,906	2,025	2,144
40				933	1,067	1,200	1,333	1,467	1,600	1,733	1,867	2,000	2,133	2,267	2,400
42				1,038	1,187	1,335	1,483	1,632	1,780	1,928	2,077	2,225	2,373	2,522	2,670
44				1,149	1,313	1,477	1,641	1,806	1,970	2,134	2,298	2,462	2,626	2,790	2,955
46				1,265	1,446	1,627	1,807	1,988	2,169	2,350	2,530	2,711	2,892	3,073	3,253
48				1,387	1,585	1,783	1,981	2,179	2,378	2,576	2,774	2,972	3,170	3,368	3,566
50				1,514	1,731	1,947	2,163	2,379	2,596	2,812	3,028	3,245	3,461	3,677	3,894
52						2,118	2,353	2,588	2,824	3,059	3,294	3,529	3,765	4,000	4,235
54						2,296	2,551	2,806	3,061	3,316	3,571	3,826	4,081	4,336	4,591
56						2,481	2,756	3,032	3,308	3,583	3,859	4,135	4,410	4,686	4,962
58						2,673	2,970	3,267	3,564	3,861	4,158	4,455	4,752	5,049	5,346
60						2,872	3,192	3,511	3,830	4,149	4,468	4,787	5,107	5,426	5,745
62						3,079	3,421	3,763	4,105	4,448	4,790	5,132	5,474	5,816	6,158
64						3,293	3,659	4,025	4,390	4,756	5,122	5,488	5,854	6,220	6,586
66						3,514	3,904	4,294	4,685	5,075	5,466	5,856	6,247	6,637	7,027
68									4,989	5,405	5,820	6,236	6,652	7,068	7,483
70									5,303	5,744	6,186	6,628	7,070	7,512	7,954
72											6,563	7,032	7,501	7,970	8,438
74											6,951	7,448	7,944	8,441	8,937
76											7,351	7,876	8,401	8,926	9,451
78											7,761	8,315	8,870	9,424	9,978
80											8,182	8,767	9,351	9,936	10,520

[1] Diameter classes are midpoint; e.g., 12-inch class includes 11.0-12.9.
NOTE.--Block indicates extent of data.

Table 22—Root mean squared errors of form factor equations

Species	Root mean squared error					
	Cubic		International 1/4-inch		Scribner	
	Ratio	*Percent*	*Ratio*	*Percent*	*Ratio*	*Percent*
Douglas-fir	0.04	11.7	0.31	14.8	0.32	17.3
Ponderosa and Jeffrey pine	.05	13.4	.40	17.6	.41	20.9
Sugar pine	.05	15.5	.44	19.3	.45	21.7
Lodgepole pine	.04	10.9	.32	13.6	.33	16.6
White fir	.04	13.2	.37	17.0	.36	18.9
California red fir	.04	13.5	.38	18.0	.38	20.3
Incense-cedar	.04	14.6	.31	19.0	.29	21.6

Table 23—Results of a test of study equations and the old local volume tables against 441 trees of known volume from the Stanislaus National Forest

Species and log rule	Mean volume per tree	Root mean squared error [1]		Aggregate difference	
		Study equations	Old local volume tables	Study equations	Old local volume tables
		- - - - - - - - - - - - - - *Percent* - - - - - - - - - - - - - - -			
Douglas-fir (15 trees):					
Cubic	114.6	19.2	27.7	10.1	-0.5
International 1/4-inch	780.6	24.9	51.0	9.1	-8.3
Scribner	677.1	31.1	48.1	10.7	-1.2
Ponderosa and Jeffrey pine (146 trees):					
Cubic	158.9	20.2	31.7	4.6	-8.5
International 1/4-inch	1,120.1	26.9	56.7	2.0	-17.0
Scribner	1,009.2	29.5	49.5	3.4	-13.3
Sugar pine (34 trees):					
Cubic	214.5	13.0	20.8	-5.2	-6.7
International 1/4-inch	1,546.5	17.6	32.1	-10.3	-13.9
Scribner	1,417.6	43.0	38.0	-9.9	-10.9
Lodgepole pine (60 trees):					
Cubic	79.0	15.8	50.5	3.8	35.0
International 1/4-inch	457.2	25.4	60.0	7.9	36.2
Scribner	411.6	30.0	77.4	4.7	41.0
White fir (86 trees):					
Cubic	168.3	15.7	22.4	-6.2	-10.8
International 1/4-inch	1,197.6	21.4	31.2	-9.7	-15.0
Scribner	1,096.7	38.1	52.4	-9.8	-12.5
California red fir (42 trees):					
Cubic	284.9	17.2	28.3	-2.6	-.1
International 1/4-inch	2,044.0	24.8	33.4	-10.2	-5.2
Scribner	1,892.6	28.1	27.4	-10.7	-2.5
Incense-cedar (58 trees):					
Cubic	117.3	20.5	39.2	-.6	-20.7
International 1/4-inch	769.9	28.1	52.8	-2.5	-23.1
Scribner	679.4	51.7	65.7	-5.0	-17.9
Combined (441 trees):					
Cubic	159.2	17.9	32.9	-.3	-5.4
International 1/4-inch	1,108.1	24.9	47.5	-3.8	-11.6
Scribner	1,005.9	34.8	43.8	-3.9	-8.1

[1] Logarithmic transformation was used to equalize variance.

Table 24—Comparative reliability of diameter-height and diameter-height-form class volume equations in estimating Stanislaus National Forest sample tree volumes

(In percent)

Equation	Cubic		International 1/4-inch		Scribner	
	Root mean squared error[1]	Aggregate difference	Root mean squared error[1]	Aggregate difference	Root mean squared error[1]	Aggregate difference
Without form class	16.2	-0.6	20.1	-4.5	23.3	-4.4
With actual form class	12.0	5.4	13.0	1.7	16.3	1.7
With average form class	16.2	-1.8	20.5	-5.7	23.7	-5.5

[1] In order to equalize variance, root mean squared errors were calculated for four factors instead of volume.

The mission of the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is to provide the knowledge, technology, and alternatives for present and future protection, management, and use of forest, range, and related environments.

Within this overall mission, the Station conducts and stimulates research to facilitate and to accelerate progress toward the following goals:

1. Providing safe and efficient technology for inventory, protection, and use of resources.

2. Developing and evaluating alternative methods and levels of resource management.

3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

The area of research encompasses Oregon, Washington, Alaska, and, in some cases, California, Hawaii, the Western States, and the Nation. Results of the research are made available promptly. Project headquarters are at:

Fairbanks, Alaska	Portland, Oregon
Juneau, Alaska	Olympia, Washington
Bend, Oregon	Seattle, Washington
Corvallis, Oregon	Wenatchee, Washington
La Grande, Oregon	

Mailing address: *Pacific Northwest Forest and Range*
Experiment Station
P.O. Box 3141
Portland, Oregon 97208